STATE OF MONTANA
[illegible] RESOURCE DAMAGE PROGRAM

ASSESSMENT OF DAMAGES TO ANGLERS AND OTHER RECREATORS FROM INJURIES TO THE UPPER CLARK FORK RIVER BASIN

DECEMBER 1993

ASSESSMENT OF DAMAGES TO ANGLERS AND OTHER RECREATORS FROM INJURIES TO THE UPPER CLARK FORK RIVER BASIN

STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

Prepared by:

RCG/Hagler Bailly
P.O. Drawer O
Boulder, CO 80306-1906
(303) 449-5515

Primary Authors:

Edward R. Morey
Robert D. Rowe

Contributing Authors:

William S. Breffle
W. Douglass Shaw

DECEMBER 1993

CONTENTS

CONTENTS

CONTENTS

CONTENTS

TABLES

TABLES

FIGURES

ACRONYMS

CBM	Contingent Behavior Model
CDF	Cumulative Density Function
CFS	Cubic Feet per Second
CVM	Contingent Valuation Method
DOI	Department of the Interior
ECR	Expected Catch Rate
MPH	Miles per Hour
NA	Not Applicable
NRDA	Natural Resource Damage Assessment
RDM	Recreation Demand Model
SMRF	Southwestern Montana Recreational Fishing
TCM	Travel Cost Model
WTA	Willingness to Accept
WTP	Willingness to Pay

1.0 INTRODUCTION

1.1 OVERVIEW

Releases of hazardous substances from mining and mineral processing wastes have injured natural resources in the upper Clark Fork River and Silver Bow Creek. These injuries include reduced fish stocks, contaminated soils, reduced vegetation, and reduced wildlife habitat and populations. As a result of these injuries, anglers and nonfishing recreators experience reductions in the services provided by the natural resources, which translate into damages. Past, present, and future fishing and nonfishing recreational use value damages are measured in this report.

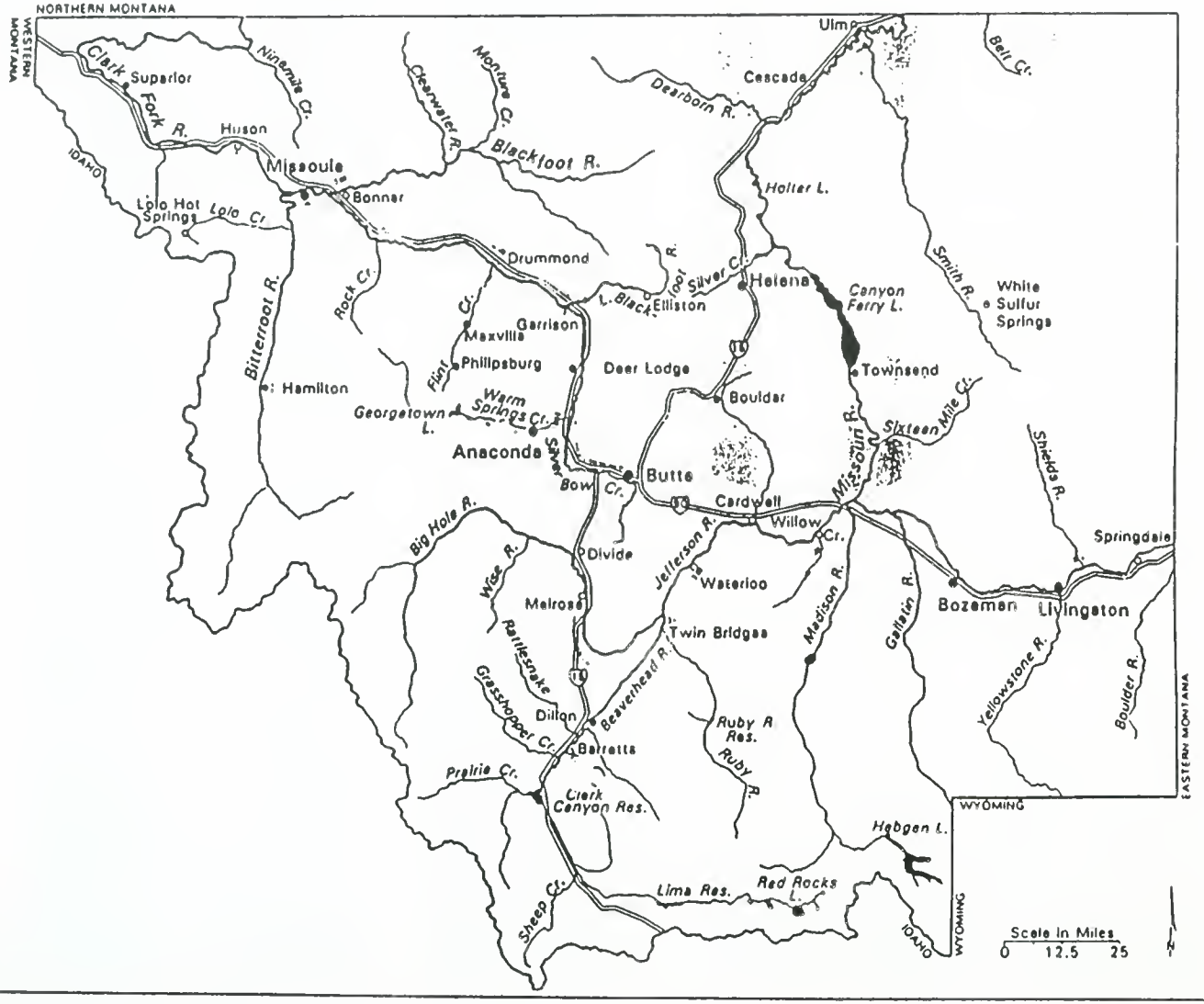
Reduced fisheries stocks lead to reductions in the expected catch rates for anglers at these sites and, combined with other natural resource injuries, cause damages to anglers who might choose to use the sites. Damages to anglers include, but are not limited to: (1) reduced benefits from trips to the injured sites due to reductions in the expected catch rates at the sites; (2) losses associated with taking trips to substitute sites that are less preferred than the Clark Fork River and Silver Bow Creek if these sites were not injured by the releases of hazardous substances; and (3) losses associated with taking fewer total fishing trips than they would take if the sites were uninjured.

The injuries to fish stocks, vegetation, and wildlife also cause damages to individuals who enjoy nonfishing recreational activities such as hiking, picnicking, and wildlife viewing near rivers and streams. These individuals receive fewer benefits from their trips to the Clark Fork River and Silver Bow Creek than they would in the absence of injuries, incur losses by taking more trips to substitute sites that are less preferred, and incur losses by taking fewer nonfishing recreational trips to rivers and streams in the area than they would in the absence of injuries.

This report specifically estimates past, present, and future fishing and nonfishing recreation use value damages for Silver Bow Creek and the upper Clark Fork River between Warm Springs Ponds and the Milltown Dam due to the release of hazardous substances from mining and mineral processing wastes. The impacted sites are depicted in Figure 1-1.

The remainder of this chapter introduces the injuries in the upper Clark Fork River Basin that affect fishing and nonfishing recreation, provides additional discussion of how these injuries cause damages to recreators, and introduces the concepts, measurements, and models used to estimate seasonal and annual damages.

Figure 1-1
Map of Southwestern Montana



1.2 INJURIES IN THE UPPER CLARK FORK RIVER BASIN

This section of the report briefly introduces the natural resource injuries that affect recreational activities in the upper Clark Fork River Basin. Additional information on these injuries can be found in the injury assessment reports (Lipton *et al.*, 1993a; Lipton *et al.*, 1993b). In this and following discussions the term *injured conditions* refers to the 1992 conditions at the impacted sites. The term *baseline conditions* refers to the conditions that would exist at the sites if releases of hazardous substances had not occurred.

1.2.1 Mining Wastes and the Injured Area

Releases of hazardous substances have injured natural resources in Silver Bow Creek and the Clark Fork River from Butte downstream to Missoula. Injured resources include fisheries, wildlife, and riparian vegetation. The period of releases extends back to the late 1800s, and releases continue today.

1.2.2 Injuries to Fisheries

Fish in the assessment area have been and continue to be exposed to and injured by hazardous substances by direct contact with contaminated surface water and sediments as well as through food-chain consumption of contaminated prey (Lipton *et al.*, 1993a). Specifically, the injuries to the fisheries result in smaller trout stocks than would exist without the injuries.[1] For example, Silver Bow Creek, which extends approximately 30 miles between Butte and Warm Springs Ponds, is unable to support any trout.

1.2.3 Injuries to Wildlife and Vegetation in the Riparian Areas

Studies have confirmed that riparian soils, vegetation, and wildlife habitat in the upper Clark Fork Basin along Silver Bow Creek and the upper Clark Fork River have been exposed to and injured by hazardous substances (Lipton *et al.*, 1993b).

[1] This report focuses on trout because anglers predominantly target trout at Southwestern Montana rivers and streams.

1.3 THE RESULTING DAMAGES TO ANGLERS AND OTHER RECREATORS

How Damages Arise

The expected catch rates for trout in Silver Bow Creek and the Clark Fork River are lower than they would be in baseline conditions. We define a site's expected catch rate as what an average angler's catch rate for trout would be on an average day at the site. If the stock size is zero, the expected catch rate is zero, and the expected catch rate increases as the stock size increases. Reduced catch rates lead to reduced service flows and to damages because:

1. Anglers continue to take trips to the injured sites, but they experience lower catch rates and lower fishing enjoyment than they would under baseline conditions. Because enjoyment of the site is reduced, anglers experience damages.

2. To minimize damages to themselves, anglers will substitute fishing trips to other sites rather than fish at the injured sites. The anglers are worse off because they would have preferred to have fished at the impacted sites under baseline conditions rather than at the substitute sites.

3. To minimize the damages to themselves, anglers will forgo taking some fishing trips and will participate in other activities rather than fishing at the injured sites. The anglers are worse off (damaged) because if the sites were in baseline conditions they would have preferred to take more fishing trips rather than participate in the other substitute activities.

Because the second response is estimated to be one of the most significant responses and sources of damages, it is important to make clear that substituting fishing trips away from the injured sites to other fishing sites does, in fact, result in damages to the anglers. Anglers who live close to the impacted sites must now travel farther to fish than they would otherwise have to, and may substitute to sites with the same or lower fishing quality than the impacted sites if the impacted sites were in baseline conditions. These individuals are damaged by experiencing both higher fishing costs and reduced enjoyment at the substitute sites as compared to what they would have experienced if Silver Bow Creek and the Clark Fork River were uninjured.

Anglers who live far from the impacted sites, and perhaps closer to other substitute sites, are also damaged if they would have chosen to fish at Silver Bow Creek and the Clark Fork River under baseline conditions. These individuals would be willing to incur higher travel costs to visit Silver Bow Creek and the Clark Fork River under baseline conditions rather than visit other closer sites because these added costs are less than the added value they assign to visiting the impacted sites under baseline conditions. For example,

the angler might value visiting a Clark Fork River site under baseline conditions at $25 more than visiting another closer site, even though it costs $10 more in travel costs to visit the Clark Fork River site. By reducing the fishing quality at the Clark Fork River site the individual may save $10 in travel costs by instead visiting the substitute site, but he loses the $25 added value he assigned to being able to fish at the Clark Fork site under baseline conditions. In this example, the angler experiences trip damages worth $15 because of injuries to the Clark Fork River.

At least two studies indicate that fishing activity levels at Silver Bow Creek and the Clark Fork River are well below use levels at other rivers and streams in Southwestern Montana, even though Silver Bow Creek and the upper reaches of the Clark Fork River are close to Butte, and much of the upper Clark Fork River is near Missoula (Hagmann, 1979; McFarland, 1989).

The same sources of damages also impact nonfishing recreators. Their behavior is also influenced by the injuries to surface water, sediments, wildlife, riparian habitat, and vegetation.

Willingness to Pay and Willingness to Accept Compensation

There are two conventional measures of the damages an angler experiences because the expected catch rates are not at baseline levels. One measure of damages is the angler's willingness to pay (WTP) above current expenditures to have available the baseline expected catch rates. Another measure of damages is the amount of money the angler would have to *be paid* to voluntarily forego the opportunity to experience the baseline expected catch rates. This is the angler's willingness to accept (WTA) the injury-level expected catch rates. WTP and WTA measure damages because individuals are not able to fish at the sites with expected catch rates at their baseline levels. In absolute terms, WTA exceeds WTP for the baseline expected catch rates.

WTA is the appropriate measure of damages if one assumes the angler has a right to the baseline expected catch rates and should be compensated if he or she is forced to accept the current, injury-level expected catch rates. WTP is the appropriate measure of damages if the angler does not have a vested right to the baseline expected catch rates. We estimated both WTP and WTA for each angler in our sample but only report WTP because our estimated WTP and WTA are effectively equal.[2]

[2] If WTA and WTP were significantly different, both estimates would have been reported, and WTA may have been the more appropriate measure of damages. The theoretical derivations of WTP and WTA are presented in Appendix 7A.

1.3.1 Determinants of Individual Damages

Associated with each fishing trip are expected benefits and expected costs. The expected benefits from a trip to a site are an increasing function of the site's expected catch rate. Expected costs include transportation, lodging and equipment expenses, and the time spent in travel and at the site. The angler will not take a trip to a site if the expected costs exceeds the expected benefits (i.e., if expected net benefits are negative). As the total number of trips increases, the costs of each additional trip remain the same, but the expected benefits from each additional trip decline.[3] The angler stops taking more trips when the expected net benefits from the next trip are negative. The sum of expected net benefits received from all the trips taken is a measure of how the angler values the available fishing sites. The sum of these expected net benefits is how much the angler would be willing to pay above current expenditures to have the sites available and is an increasing function of each site's expected catch rate. Put simply, the sum of the expected net benefits from fishing trips will be greater the better the available fishing sites. WTP for the baseline (no-injury) expected catch rates is therefore the maximum the angler would pay to have available the baseline expected catch rates instead of the injury-level expected catch rates.

An angler's WTP for baseline expected catch rates at the Clark Fork River and Silver Bow Creek depends on the angler's income, avidity for fishing, and how close the angler lives to these sites. Everything else constant, the lower an angler's trip costs to the Clark Fork River and Silver Bow Creek, the greater will be the angler's expected net benefits from trips to these sites, and the more the angler will be willing to pay for higher expected catch rates. Since the cost of a trip to site j is a decreasing function of how close one lives to site j, WTP will be greatest for those who live near Silver Bow Creek and the Clark Fork River and lowest for nonresidents who must incur large costs to fish in Montana. Everything else constant, those whose characteristics (e.g., skill level, amount of available free time) make them more avid anglers will typically have higher WTP. Finally, WTP typically increases with income for most anglers; the more money one has, the greater the ability to pay.

Estimates of Willingness to Pay for Fishing from Previous Studies

Previous studies indicate that the WTP of anglers to have available the baseline expected catch rates at the Clark Fork River and Silver Bow Creek is substantial. The studies, for the most part, estimate net benefits per trip for the existence of specific rivers and streams in Montana. However, some provide estimates of WTP for either higher catch

[3] If this were not the case, anglers would do nothing but fish.

rates or bigger fish.[4] Many of these studies explicitly consider rivers and streams in the Clark Fork River Basin. For example, Duffield (1991) reports estimates of average net benefits per trip for each of the following four rivers: Rock Creek, the Blackfoot River, the Bitterroot River, and the upper Clark Fork River. These estimates of net benefits are derived from a recreation demand model and are $135 per trip for Rock Creek, $79 per trip for the Blackfoot, $55 per trip for the Bitterroot, and $44 per trip for the upper Clark Fork. Although these studies do not directly estimate annual WTP for the baseline catch rates at the Clark Fork River and Silver Bow Creek, they do indicate that trips to sites with high expected catch rates (e.g., Rock Creek) are valued much more highly than trips to sites with lower expected catch rates. Currently, Rock Creek has the highest expected catch rate for trout of all of the rivers and streams in the upper Clark Fork River Basin. Using a contingent valuation survey that determines net benefits by asking each individual in a sample his or her willingness to pay for fishing sites and conditions, Duffield (1989) estimates that the average net benefits from a trip to Rock Creek are $218, and that individuals would pay on average $80 to $100 per trip not to have the conditions at Rock Creek deteriorate to a point at which the expected catch is reduced by half, a reduction comparable to the catch rate reduction one would experience by fishing the upper Clark Fork River rather than Rock Creek.

Duffield *et al.* (1988) report contingent valuation estimates of average net benefits per trip for 19 rivers in Montana. These estimates vary across rivers from $58 per trip for the Bitterroot to $228 per trip for the Madison; the average net benefit for a trip to the Clark Fork is $87. These estimates indicate that net benefits per trip are large and vary significantly as a function of the quality of the site visited. This study also indicates that willingness to pay for the availability of a site varies significantly across anglers as a function of their avidity for fishing. It reports an average net benefit per trip over all 19 rivers of $8 for *occasional* users and $170 for those who are *avid* users of the site; the average for all users is $117. This study also indicates anglers are willing to pay for both higher catch rates and bigger fish. Duffield *et al.* (1987) also report net benefits per trip that are high but vary significantly across rivers. In addition, they estimate that the net average benefits to anglers for river and stream fishing is $113 per trip.

Although these studies provide useful information, none of them directly estimates annual WTP for the baseline expected catch rates in the Clark Fork River and Silver Bow Creek. In addition, these previous studies measure willingness to pay on a per-trip basis, and per-trip measures cannot be easily transferred into seasonal or annual estimates of damages unless one has some separate estimate of how many trips an individual will take to each site and how that number of trips would differ if the conditions of the sites were different. Therefore, we have undertaken state-of-the-art

[4] In many of these studies, different estimates are often reported for the same scenario, and the estimates vary as a function of their underlying assumptions. We report representative estimates from these studies.

applications of accepted NRDA methods, including several new primary survey efforts, to estimate directly the damages resulting from the injuries to the Clark Fork River and Silver Bow Creek. The previous studies provide useful cross-check information.

1.4 METHOD OF ANALYSIS

1.4.1 The Recreation Demand Model of Participation and Site Choice

A state-of-the-art recreation demand model was developed that predicts how many trips an angler takes (the participation decision) and the choice of sites as a function of trip costs, expected catch rates, sizes of sites, and characteristics of the angler such as gender, age, skill level, and amount of available free time.[5] Parameters in the model were chosen to best explain the observed trip patterns for a sample of 443 resident and nonresident Montana anglers. The model was then used to estimate both the damages to anglers and how their behavior has been influenced by the existence of the lower level of expected catch rates as compared to baseline expected catch rates.

Recreation demand models date back to 1959 (see Clawson, 1959). The Department of the Interior (DOI) NRDA regulations recognize the methodology as "a best available procedure" to estimate use value damages for recreational sites [43 CFR § 11.83 (d)(3) and Proposed 43 CFR § 11.83 (c)(2)(ii)(B)]. In addition, recreation demand models are widely used by the U.S. Forest Service, the U.S. DOI, and the U.S. Environmental Protection Agency to make policy decisions.

There are many variations on the basic recreation demand model (see Bockstael *et al.*, 1991). The model developed here is a three-level, nested logit, random utility model of individual participation and site choice. The model is described in detail in Chapter 4.0.[6] It explicitly considers substitution across sites as a function of trip costs and site characteristics, so it can be used to predict how an angler's choice of sites would differ if the expected catch rates at the Clark Fork River and Silver Bow Creek were at baseline levels. The model also explicitly considers substitution in and out of fishing, so it can be used to predict how an angler's total number of trips to rivers and streams in Southwestern Montana would change if the expected catch rates at the Clark Fork River and Silver Bow Creek were at baseline levels. Failure to incorporate this ability to

[5] Recreation demand models are often referred to as travel cost models (TCMs) because travel costs are one of the significant determinants of how many trips an individual will take and which sites will be visited.

[6] Other random utility models of recreation demand include Bockstael *et al.*, 1987; Hanemann and Carson, 1987; Morey *et al.*, 1991; Parsons and Kealy, 1992; and Morey *et al.*, 1993.

substitute would bias the damage estimates upward.[7] The need to address substitutability across sites and activities when estimating the damages from injuries at sites is further discussed in the DOI NRDA regulations [CFR 43 § 11.84 (f)].

Recreation demand model estimates of both participation and site choice require data on a sample of anglers, where for each angler in the sample there is a record of the total number of fishing trips the angler took during the summer season to rivers and streams in Southwestern Montana and information on where the individual fished. There were no existing data sets with this type of information. We used an in-field intercept survey followed by telephone and mail follow-up surveys to obtain data for a sample of 443 Montana anglers, including how many trips each of these anglers took to rivers and streams in Southwestern Montana between May and September 1992, and which sites they visited. During the in-field intercept survey, extensive catch data were also collected. The surveys and data collection effort are described in detail in Chapter 2.0.

From the estimated recreation demand model one can determine the expected net benefits an angler receives from fishing at the rivers and streams in Southwestern Montana. This follows because a model that explains participation and site choice as a function of trip costs and site characteristics implicitly measures benefits. For example, if the model predicts that an individual will take three trips, the total benefits from the third trip must be greater than the known cost of a trip to that site. When the model predicts that an angler will choose a more costly site with a high expected catch rate over a less costly site with a low expected catch rate, it is because the increase in benefits from the higher expected catch rate is greater than the increase in trip costs.

Because anglers prefer higher catch rates, the expected net benefits with the baseline expected catch rates are greater than the expected net benefits with the current, injury-level expected catch rates. WTP for the baseline expected catch rates is the amount of money one would have to take from the angler if there were no injuries to equate the net benefits with the baseline expected catch rates and the net benefits with the current, injury-level expected catch rates.

1.4.2 Summary of Damages to Anglers

The 1992 summer season WTP for the baseline expected catch rates was estimated for each of the 443 anglers in our sample as a function of the angler's trip costs, income, age, gender, available free time, and other characteristics.[8] For anglers who are residents of

[7] For more details, see Caulkins *et al.*, 1985; Morey *et al.*, 1991; Hanemann and Morey, 1992; and Morey *et al.*, 1993.

[8] The summer season is defined as May through September 1992.

Montana, estimated summer WTP ranges from $11.95 to $275.69 with a mean of $75.28 and a median of $72.49. For anglers who are not residents of Montana, estimated summer WTP ranges from $0.29 to $50.52 with a mean of $13.25 and a median of $11.52. The $75.28 is an estimate of what an average resident angler in our sample would pay for the summer season to have available the baseline expected catch rates, and $13.25 is an estimate of what a representative nonresident angler in our sample would pay to have available the baseline expected catch rates.

We estimate that in 1992 there were 71,239 resident anglers and 65,708 nonresident anglers active at rivers and streams in Southwestern Montana. Additionally, we estimate that the average angler in our sample is approximately three times as avid (i.e., takes three times as many trips) as the average angler in the population who is active in Southwestern Montana. As a result, damages for the typical angler are about one-third of the damages from anglers in our sample (see Chapter 7.0 for details). Therefore, to compute aggregate damages for all anglers, we reduce the per-angler damages by about two-thirds, which equal $22.58 for residents and $4.64 for nonresidents. The estimate of the summer damages to anglers in 1992 from not having available the baseline expected catch rates is $1.9 million, $1.6 million for residents and $305 thousand for nonresidents.[9] Damages to resident (nonresident) anglers for other years can be obtained by multiplying $22.58 ($4.64) by the estimated number of resident (nonresident) anglers in each year who fish rivers and streams in Southwestern Montana. Winter damages to anglers are also substantial and are calculated in Chapter 9.0.

1.4.3 Summary of Damages to Nonfishing Recreators

Many individuals take trips to rivers and streams in Southwestern Montana for purposes other than fishing. The 1992 summer damages to nonfishing recreators were estimated as follows. First, the recreation demand model was used to estimate the number of additional fishing trips that would occur in the absence of injuries to the Clark Fork River and Silver Bow Creek. Second, the ratio of the change in nonfishing recreation trips to the change in fishing trips under baseline conditions was calculated. Third, the estimated number of additional fishing trips and the ratio were then used to estimate that there would have been 17,192 more nonfishing recreation trips in the summer season of 1992 to the impacted sites if there had been no injuries. Per-trip net benefits for a nonfishing trip with the baseline expected catch rates available is estimated to be $36.73 based on ratios of nonfishing recreation values to fishing values in the existing literature and per-trip fishing benefits estimated in this report (see Chapter 8.0 for details). This value is representative of trips that involve activities such as floating, picnicking, and hiking, the types of activities most frequently reported by nonfishing recreators on trips to

[9] (71,239 multiplied by ($75.28 × 0.30)) plus (65,708 multiplied by (13.25 × 0.35)).

Southwestern Montana. The 1992 aggregate summer damages to nonfishing recreators are therefore $631,000, the increase in the number of additional trips multiplied by $36.73. Damage estimates for other years are obtained in the same manner and are reported in Chapter 9.0.

1.5 REPORT ORGANIZATION

The rest of the report is organized as follows. Chapter 2.0 describes in-field, telephone, and mail surveys used to collect data to estimate damages. Chapter 3.0 summarizes the results of these new surveys. Chapter 4.0 provides additional discussion of the recreation demand model used to estimate expected catch rates at fishing sites, to predict how often and where anglers fish, and to measure damages from natural resource injuries at the study sites. Chapter 5.0 provides the results of the model when estimated under current 1992 conditions at sites in Southwestern Montana. Chapter 6.0 presents the stock/harvest model that estimates expected catch rates as a function of stock estimates. Chapter 7.0 then estimates changes in fishing use and the associated summer season damages in 1992 if trout stocks and expected catch rates were at their baseline levels at Silver Bow Creek and the Clark Fork River. Chapter 8.0 presents the nonfishing recreation damage analysis for the summer season of 1992. Chapter 9.0 extends the 1992 summer results to aggregate annual fishing and nonfishing damages for the past (from 1971 through 1992), present, and future.

2.0 SURVEY DESIGNS

2.1 OBJECTIVES OF DATA COLLECTION

The objectives of the data collection effort were to acquire data necessary to estimate a model of recreation demand. The data were also used to obtain, extend, and improve estimates of:

- Total and site-specific fishing and nonfishing recreation participation rates at Southwestern Montana rivers and streams
- Expected catch rates
- Fishing site characteristics
- Anglers' attitudes toward specific sites and fishing in general at Southwestern Montana rivers and streams
- Demographic and socioeconomic characteristics of anglers.

The basic data collected from a sample of anglers and other sources include individual trip records for each angler for the 1992 summer season (how often each angler fished and the destinations on some of the trips from May through September) for all rivers and streams in Southwestern Montana. Also collected were individual reported catch rates, data on the sizes of various sites, data on trip costs, demographic and socioeconomic data that influence where and how often anglers fish, and data on angler attitudes about fishing at rivers and streams in Southwestern Montana.

Four survey components were used to collect the data, including:

- An in-field intercept survey
- An in-field postcard survey
- A telephone follow-up survey of anglers
- A mail follow-up survey of anglers.

2.2 RIVERS AND STREAMS IN SOUTHWESTERN MONTANA

The data collection effort focused on all rivers and streams in Southwestern Montana. These rivers and streams are predominantly cold water fishing sites where the main species sought for recreational fishing is trout.[1] We divided Montana into five regions. The regions were chosen to reflect population concentrations with the assumption that anglers take more fishing trips in their own region than in other regions. We define four regions in Southwestern Montana: Missoula (M), Butte/Dillon (BU), Helena (H), and Bozeman (BZ). A fifth region (Other) is used to categorize all fishing trips to Montana rivers and streams outside of Southwestern Montana. While data were collected for all rivers and streams in Southwestern Montana, there are more complete data for some rivers and streams (sites chosen for "intensive study") than for others. Catch rates were only collected for the 26 sites chosen for intensive study.[2] The 26 intensively studied sites and the four regions in Southwestern Montana are listed and defined in Table 2-1 and are represented on the map of Southwestern Montana in Figure 2-1.[3] The six impacted sites in the upper Clark Fork River Basin, as listed in Table 2-1, are: #1.) UCF 1; #2.) UCF 2; #3.) UCF 3; #12.) UCF 4; #13.) UCF 5; and #14.) Silver Bow Creek.

The 26 intensively studied sites include the injured sites in the Clark Fork Basin, substitute sites, and comparable sites. Criteria for choosing the set of sites for intensive study included geographic distribution over Southwestern Montana, variability in expected catch rates, and sites that account for a significant portion of fishing trips taken in Southwestern Montana. For a given angler, distances to the sites vary across the 26 sites. This geographic variation is needed to determine the importance of distance in determining where and how often anglers fish. These sites are also highly varied in site size and expected catch rate because size and expected catch rate are important in determining where and how often anglers fish. To determine statistically the importance of these variables, size and expected catch rate must also vary across sites. Additionally, sites chosen for intensive study in a given region are expected to be the destinations of a significant percentage of all fishing trips to the region so that the statistics obtained are representative of the majority of fishing trips. Finally, the catch rate of each site chosen for intensive study is roughly homogeneous across the site. Therefore, the variation in expected catch rate within a site is expected to be less significant in explaining recreation patterns than the variation in catch rates across sites.

---

[1] Chapter 3.0 shows that the data indicate trout is the primary species sought by anglers.

[2] Originally, 27 rivers and streams were chosen for the analysis, but one was eliminated before the data collection effort began. Warm Springs Ponds was also included because the upper Clark Fork River has its headwaters there, but this site was not open for much of the summer of 1992. Some of the 26 sites actually represent only a stretch, or reach, of the river or stream, not the entire river or stream.

[3] Hereafter, the term *Southwestern Montana* indicates the area depicted in Figure 2-1.

Table 2-1
List of Intensively Studied Sites*

Missoula Region

1. Upper Clark Fork 1 (UCF 1) - Bonner to Rock Creek
2. Upper Clark Fork 2 (UCF 2) - Rock Creek to Flint Creek
3. Upper Clark Fork 3 (UCF 3) - Flint Creek to L. Blackfoot
4. Middle Clark Fork - Spurgin Rd. to Huson
5. Rock Cr. - 1 mile up from Clark Fork to Siria
6. Flint Cr. - Maxville to Black Pine Rd.
7. Bitterroot 1 - Maclay Br. to Chief Looking Glass
8. Bitterroot 2 - Angler's Roost to Hannon Mem.
9. Lolo Cr. - Mormon Cr. to Lolo Hot Springs
10. Blackfoot - Bonner to Whitaker Br.
11. L. Blackfoot - Cutoff Rd. to Elliston

Butte/Dillon Region

12. Upper Clark Fork 4 (UCF 4) - L. Blackfoot to Perkins L.
13. Upper Clark Fork 5 (UCF 5) - Perkins L. to Pond 2 Outfall
14. Silver Bow Cr. - Ponds to Butte
15. Warm Springs Cr. (WSC) - Fish Hatchery to Meyer's Dam
*16. Warm Springs Ponds
17. Big Hole 1 - Pennington Br. to Brown's Br.
18. Big Hole 2 - Melrose to Divide
19. Jefferson 2 - Waterloo to Twin Bridges
20. Beaverhead - Barretts to Clark Canyon
28. Jefferson 1 - Willow Cr. to Cardwell

Helena Region

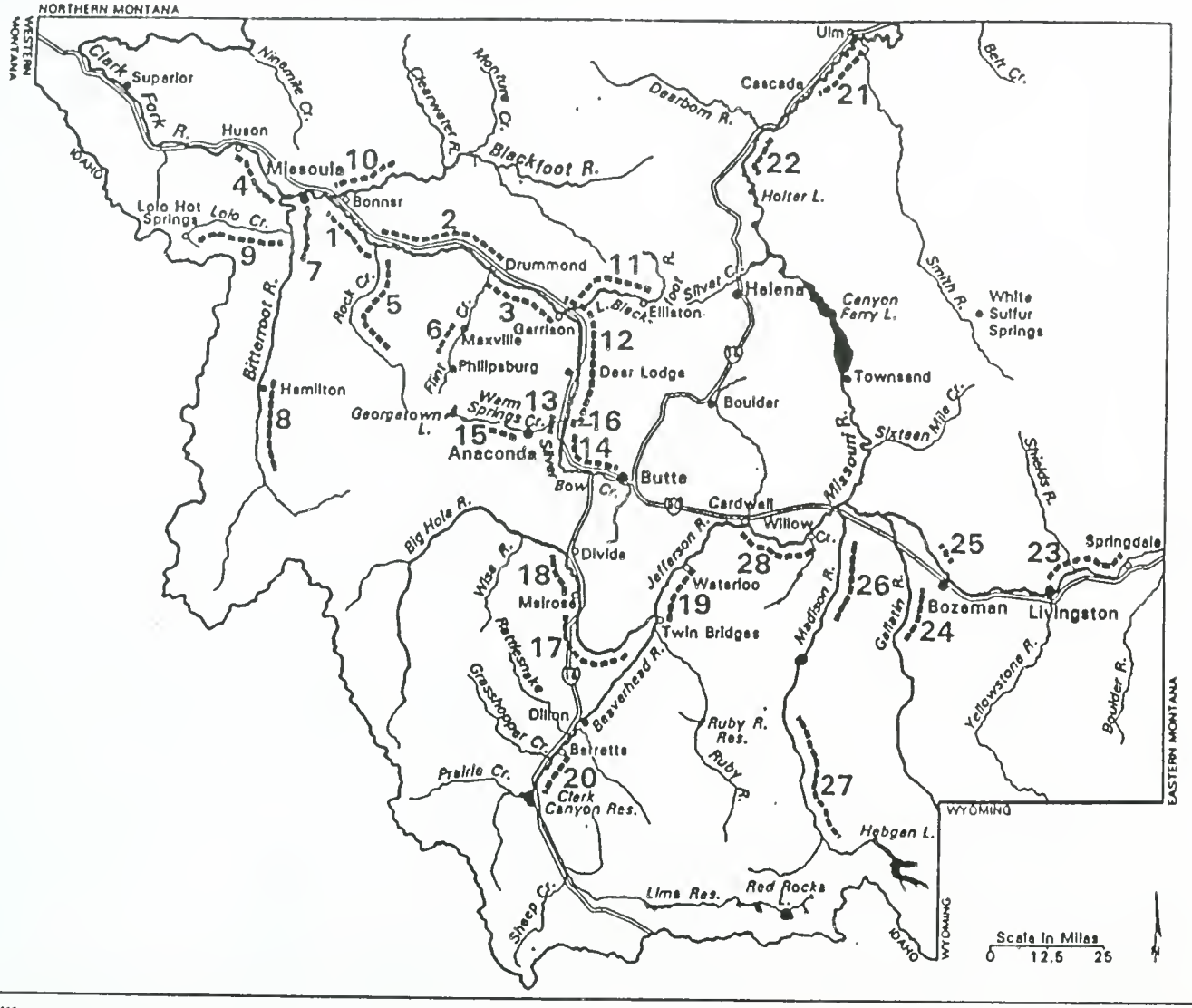
*21. Missouri 1 - Ulm to Cascade
22. Missouri 2 - Dearborn R. to Holter Dam

Bozeman Region

23. L. Yellowstone - Springdale to Livingston
24. Gallatin - Shedd Br. to Spanish Cr.
25. E. Gallatin - Spain L. Br. to Griffen Dr.
26. Madison 1 - Cobblestone to Beartrap
27. Madison 2 - Varney to Lyons

* Sites 16 and 21 were not included for study. Site 21 was omitted prior to any survey implementation. Site 16 is not a river or stream and was not open for much of the summer season.

Figure 2-1
Map of Southwestern Montana Showing the 26 Intensively Studied Sites



2.3 DATA COLLECTION METHOD AND SAMPLE OF RECREATIONAL ANGLERS

One of the primary goals of the data collection effort was to obtain an accurate record of all river and stream fishing activities for a set of anglers for the 1992 summer fishing season. The survey strategy was composed of the following sets of activities:

- Contacting anglers and nonfishing recreators with an in-field intercept survey and an in-field postcard survey
- Acquiring data on catch rates at the time of initial contact
- Attaining complete trip records by following a subgroup of the intercepted anglers for the rest of the season with telephone and mail surveys.

This strategy of using multiple survey instruments and repeated contacts was adopted to minimize or eliminate the potential for recall bias in the reporting of the number and destinations of trips anglers took during the season. The survey efforts are further described below.

In-Field Intercept Survey

In-field intercept surveys were conducted to establish initial contact with anglers who would be followed up throughout the rest of the season and to collect site-specific catch rate data. The intercept survey contains four sections: set-up questions, questions about the angler's intercept trip including catch data for the trip, questions about trips prior to the intercept trip, and questions about the angler.[4] Respondents were asked on this survey how many trips they had taken since May 1 and where they went on their most recent trips.

Intercept surveys were conducted at each of the 26 intensively studied sites on various days and times determined by a stratified sampling plan (Duffield *et al.*, 1992a). The sampling plan was designed so that each angler at a given site had an equal probability of being intercepted during the season (Duffield *et al.*, 1992b). Intercepts began on May 1 and ended on August 23, 1992. The intercept season was divided into eight "waves" tied to the follow-up telephone and mail survey strategy to minimize the potential for recall bias in the reporting of trip data. Each wave lasted approximately two weeks. Exact wave dates are reported in Table 2-2. Intercepts were conducted by a field crew trained to follow a strict routine, schedule, and protocol. Details on this protocol, the sample

[4] The intercept survey questionnaire was pretested twice in April 1992, and the final version appears in Appendix 2A.

Table 2-2
Definitions of Waves for Intercept Survey

Wave One: May 1st through May 17th
Wave Two: May 18th through May 31st
Wave Three: June 1st through June 14th
Wave Four: June 15th through June 28th
Wave Five: June 29th through July 12th
Wave Six: July 13th through July 26th
Wave Seven: July 27th through August 9th
Wave Eight: August 10th through August 23rd

design, and the routes followed can be found in The Survey Agent Training Manual (Duffield, 1992). A total of 1,951 anglers were intercepted in the 1992 summer season, and of those intercepted, 98 percent completed some or all of the questions. At the end of each intercept wave, all intercept questionnaires were sent in for double-entry coding.

In-Field Postcard Survey

The postcard survey includes questions relating to nonfishing recreational use. A copy of the postcard appears in Appendix 2A. It was also used as an independent, secondary check on angler and nonangler recreation visitation at each of the 26 intensively studied sites. The postcard survey was implemented concurrently with the in-field intercept survey by the same survey agents during the period May 1 through August 23, 1992. Agents placed a postcard with return postage on all automobiles encountered at the rivers chosen for intensive study, and all license plate numbers of automobiles on which the postcard was placed were recorded to monitor postcard return rates. Recreators were asked to return the postcards through the mail. Activities for all people in each automobile were recorded on the postcard.

The postcards were left on automobiles at pre-specified sampling locations. These locations were chosen primarily to support the recreational fishing analysis. Including locations that may support nonfishing recreation, rather than fishing recreation, was not a

primary consideration, and nonfishing sites may be proportionately undersampled. Therefore, nonfishing recreation participation may be understated.

The overall postcard response rate for all 26 sites is 47 percent and includes 2,224 returned postcards covering the activities of 6,346 recreational visitors in Southwestern Montana. Detailed response rates are provided in Table 2-3.

Follow-Up Group

A group of individuals from each intercept wave was chosen to be followed up for the rest of the season based on a stratified random sampling procedure using the postcard proportions for fishing activity at the 26 sites.[5] Postcard data were used to select follow-up sample proportions because the intercept survey may misrepresent the actual proportions of anglers at the different sites. For example, the intercept survey may include a higher proportion of anglers at less popular sites and a lower proportion of anglers at more popular sites due to limitations on the survey agent's on-site time. Therefore, a random sample of the intercepted anglers may misrepresent relative participation rates across the sites. Because the postcards were placed on every automobile at all sites, and because the response rates to the postcard survey are comparable across sites, the postcard proportions of anglers across sites provide better estimates of the proportions of anglers at each of the 26 sites than do the intercept survey proportions. In essence, use of the postcard proportions corrects for possible bias due to constraints on the interviewer's time at popular sites.

For each intercept wave, a three-step sampling process was used to generate the follow-up sample:

- A total number of anglers was selected to be included in the follow-up sample.
- The postcard proportions of anglers at the 26 sites were used to determine the number of anglers to be selected from those intercepted at each site.
- A random sample of anglers at each site was drawn to equal the target sample size for each site.

As a result of this procedure, the percentages of anglers at each intercept site who were successfully followed up for the rest of the season are similar to the percentages of anglers at each site measured by the postcard survey for all waves. The similarity of

[5] Some intercepted anglers were not considered candidates for follow-up because the information they provided on the intercept survey was incomplete. For example, if the address was missing, an angler could not be followed up.

Table 2-3
Postcard Response Data

Site	Total Postcards Distributed	Total Postcards Returned	Percent Returned
UCF 1	116	76	65.5%
UCF 2	62	32	51.6%
UCF 3	35	10	28.6%
Middle CF	285	125	43.9%
Rock Cr.	276	115	41.7%
Flint Cr.	32	23	71.9%
Bitterroot 1	226	108	47.8%
Bitterroot 2	148	88	59.4%
Lolo Cr.	141	57	40.4%
Blackfoot	326	136	41.7%
L. Blackfoot	31	24	77.4%
UCF 4	11	4	36.4%
UCF 5	29	12	41.4%
Silver Bow Cr.	1	0	0.0%
WSC	1	1	100.0%
Big Hole 1	219	92	42.0%
Big Hole 2	219	94	43.0%
Jefferson 2	177	90	50.8%
Beaverhead	326	119	36.5%
Jefferson 1	153	75	49.0%
Missouri 2	518	251	48.5%
Yellowstone	209	95	45.5%
Gallatin	223	133	59.6%
E. Gallatin	75	47	62.3%
Madison 1	306	149	48.7%
Madison 2	600	268	44.7%

proportions is illustrated in Table 2-4. The percentages may not add to 100 percent because of rounding.

Of the 1,951 intercepted anglers, 833, or 43 percent, were chosen for follow-up. Members of the follow-up group were asked to participate in the telephone survey and the final mail survey. Within two weeks following each intercept survey wave, the follow-up sample members were selected and were sent a logsheet for recording trips taken after the intercept survey. The map delineating the four regions in Southwestern Montana and the 26 intensively studied sites was also sent to aid respondents. The data collected on the log were then reported during the telephone survey or on the mail survey. The logsheet was used to help minimize the potential for recall bias. Each respondent was encouraged to use the logsheet and had the opportunity to request a new logsheet during each telephone interview. Five versions of the logsheet were used throughout the season. A copy of each logsheet can be found in Appendix 2A. The versions differ only in the start or end dates of the periods covered by the logs. The differences between logsheets were necessary because of the staggered schedule of the intercept survey waves and the follow-up telephone survey waves.

Telephone Survey

Repeated telephone survey waves were conducted to obtain information on anglers' most recent fishing trips. These data were combined with the intercept survey data and the mail survey data to develop the season trip records used in the recreation demand model. A copy of this telephone survey appears in Appendix 2B. During each telephone contact, respondents were asked how many times they had fished since they had last been contacted and to provide information about the destinations for up to three trips. This type of approach minimizes the potential for recall bias.

Anglers intercepted earlier in the season received more calls than those intercepted later, and the total number of telephone contacts ranged from zero to two.[6] Calls were separated by approximately equal intervals. For example, if an angler was designated to be contacted by telephone and if two months were left in the season, he or she would have been telephoned approximately one month following the intercept, and then contacted by mail at the end of the season. The telephone survey was conducted using standard procedures by the University of Idaho Social Survey Research Unit. The overall response rate to the telephone survey was 83 percent.[7]

[6] Those intercepted from May 1 through June 28 (waves one through four) received two telephone calls while those intercepted from June 29 through July 26 (waves five and six) received one. Anyone intercepted after July 26 (waves seven and eight) did not receive any telephone calls, but a subsample was followed up by the final mail survey.

[7] Detailed response rates to the telephone survey by phase (first or second call) and by wave are reported in Appendix 2B.

Table 2-4
Comparison of Postcard Angler Proportions with Proportions of Intercept Anglers Followed Up

Anglers in the Postcard Survey			Anglers in the Follow-Up Survey	
River	#	% of Total	#	% of Total
UCF 1	79	2.5%	11	2.1%
UCF 2	17	0.5%	2	0.4%
UCF 3	11	0.3%	2	0.4%
Middle CF	110	3.4%	17	3.3%
Rock Cr.	148	4.6%	31	6.0%
Flint Cr.	36	1.1%	10	1.9%
Bitterroot 1	67	2.1%	10	1.9%
Bitterroot 2	221	6.9%	31	6.0%
Lolo Cr.	36	1.1%	6	1.2%
Blackfoot	91	2.8%	6	1.2%
L. Blackfoot	39	1.2%	7	1.4%
UCF 4	4	0.1%	1	0.2%
UCF 5	28	0.9%	6	1.2%
Silver Bow	0	0.0%	0	0.0%
WSC	1	0.0%	0	0.0%
Big Hole 1	178	5.6%	36	7.0%
Big Hole 2	183	5.7%	21	4.1%
Jefferson 2	144	4.5%	27	5.3%
Beaverhead	201	6.3%	41	8.0%
Jefferson 1	75	2.3%	15	2.9%
Missouri	469	14.7%	66	12.9%
Yellowstone	198	6.2%	20	3.9%
Gallatin	125	3.9%	21	4.1%
E. Gallatin	60	1.9%	14	2.7%
Madison 1	127	4.0%	22	4.3%
Madison 2	552	17.3%	90	17.5%

End-of-Season Mail Survey

The final survey instrument implemented was an end-of-season mail survey of the 833 anglers chosen to be in the follow-up group. This was the last contact of the season and was used to complete angler trip records and to collect other data. On the mail survey, anglers were asked about all trips taken since the date of last contact, which could have been the date of the first telephone call, the second telephone call, or the intercept. Thus, even if an angler was not reached for the telephone survey, we still have a complete record of the total number of trips if the angler completed the mail survey. The mail survey asked the angler to provide detailed information about the destinations on up to three of the angler's fishing trips since the date of last contact. It was also used to acquire additional information on anglers' perceptions about and attitudes toward selected fishing sites and fishing in Montana in general, the effect of increasing catch rates on their expected visitation at selected sites, socioeconomic and demographic characteristics, nonfishing recreation, and trip characteristics. Some questions on the survey were specifically designed to acquire travel-cost information from nonresidents.

Two versions of this survey were mailed in equal proportions to the anglers in the follow-up group. A copy of each version of this instrument is in Appendix 2C. The separate versions allow investigation of a broader range of sites in Questions 4 through 8 and Questions 12 through 20 than one version would have allowed. These questions deal with angler rankings of sites and then undertake a contingent ranking and participation analysis of selected sites if fishing conditions at the sites were to change. The mail survey received two waves of in-field pretesting during the late summer of 1992.

The mail survey was implemented from September 11 through November 1992 using a Dillman (1978) repeat mail procedure as outlined in Table 2-5.[8] To increase response rates, a telephone follow-up (not the telephone survey discussed above) was conducted during the week of November 2, 1992 to encourage those who had not yet returned the mail survey to do so. Of those contacted in this subsequent telephone survey, 90 percent agreed to return the mail survey. We asked those who refused to complete the mail survey to answer a few questions over the telephone to obtain demographic and trip record information for these individuals. Eight anglers of sixteen total who refused to complete the mail survey provided answers to the partial telephone survey.[9]

---

[8] For purposes of aggregation of damages in Chapters 7.0 through 9.0, our summer season is defined as May through September. While mail surveys were being returned through October and part of November, statistics derived from 1989 data from the Montana Department of Fish, Wildlife and Parks show that the amount of stream fishing in our region during October and November is significantly less than the fishing pressure from May through September (McFarland, 1992). Any inconsistency is dealt with by using an avidity correction in Chapters 7.0 through 9.0 so that aggregate damage estimates reported for our summer season (May through September) are accurate and unbiased.

[9] Copies of the telephone follow-up survey for the mail survey, the two cover letters, and the reminder postcard can also be found in Appendix 2C.

Table 2-5
Steps of Dillman's Repeat Mail Procedure

1.	First full mailing	This included a cover letter about the survey, a map identical to the one included with the logsheet, and a copy of the instrument. The first mailing occurred on September 11, 1992.
2.	Reminder postcard	Mailed to all respondents one week later on September 22, 1992.
3.	Second full mailing	This included a reminder letter, another map, and another copy of the survey instrument. This mailing was made to those from whom we had not received a completed survey form or we had a bad address return and occurred on October 9, 1992.
4.	Telephone follow-up for mail survey	The main purpose of this telephone follow-up (not to be confused with the mid-season trip record telephone survey) was to encourage nonrespondents to the final mail survey to complete and return the survey. The telephone follow-up for the mail survey occurred between November 2, 1992 and November 5, 1992.

As reported in Table 2-6, the net overall response rate to the mail survey is 62.7 percent, which is adjusted for bad addresses identified with the mail survey effort, yielding 513 respondents (505 from the mail survey plus 8 more from the telephone follow-up for the mail survey) for whom we have trip records for the 1992 summer season. There is no significant variation in response rates across the two survey versions.

2.4 SUMMARY OF THE DATA COLLECTION EFFORT

With the data from all of the surveys combined, we have information on the total number of fishing trips taken to Montana rivers and streams during the 1992 summer season for each of the 513 anglers. Additionally, we have destination information on up to 11 trips for each of these anglers (up to 2 trips from the intercept survey, up to 6 trips from the telephone contacts, and up to 3 trips from the final mail survey); at the very least we have destination information about 1 intercept trip. We also have information on individual catch rates, trip characteristics such as expenses incurred, data on angler attitudes and opinions, and demographic and socioeconomic characteristics of anglers.

Table 2-6
Mail Survey Response Rates

Description	Total	Version 1	Version 2
Questionnaires mailed	833	417	416
Bad addresses	28	12	16
Adjusted sample	805	405	400
Total response	507	258	249
Useable returns	505	258	247
% Useable returns of adjusted sample	62.7%	63.7%	61.8%
Total number of residents*	297	151	146
Total number of nonresidents*	216	113	103

* Includes responses from the telephone follow-up to mail survey.

3.0 BASIC SURVEY RESULTS

The data collected by the in-field intercept survey, the telephone follow-up survey, and the mail follow-up survey are summarized and discussed in this chapter. Analysis of these data sheds light on where and how often anglers fish in Southwestern Montana and on angler attitudes and perceptions about fishing in Montana. Such analyses help determine which variables should be included in the recreation demand model. For example, the data from the mail survey indicate expected catch rates are an important determinant of where anglers fish. As a result, expected catch rates are an important component of the recreation demand model.

It is most useful to consider the data from all surveys together. For example, season trip records, which contain information on the total number of each angler's trips and some of the destinations, are compiled using combined data from the in-field intercept survey, the telephone follow-up survey, and the mail survey. The rest of this chapter is divided into topics for discussing the data, rather than discussing the data from each survey separately.

The remainder of this chapter is divided into the following major topics: angler perceptions and attitudes, the calculation of observed catch rates, and fishing trip patterns and characteristics. Tabular summaries of the results are provided in the chapter and in Appendix 3A.

3.1 ANGLER PERCEPTIONS AND ATTITUDES

The surveys were designed to reveal how anglers evaluate different sites and to examine how important different site characteristics and respondent characteristics are in determining how often, and where, anglers fish in Southwestern Montana.

3.1.1 Catch Rates and Species are Important to Anglers

The Importance of Catch and Other Site Characteristics

Natural resource injuries at the Clark Fork River and Silver Bow Creek sites can be expected to impact fishery stocks, and therefore expected catch rates. In most studies of recreational fishing use and economic valuation, catch rates are found to be important factors in the enjoyment of fishing, in the selection of fishing sites, and in decisions on how often to go fishing. Therefore, it is important to ascertain whether anglers who fish in Southwestern Montana are concerned about the catch at different sites. The survey data suggest that anglers consider catch to be very important to the recreational fishing experience.

The mail survey (Q3) asked respondents to rank seven site characteristics, from not at all important to very important, in terms of the importance of each site characteristic in their decision about where to fish. The average rankings for these site characteristics are reported in Table 3-1. On average, anglers rated the number and size of fish as the most important site characteristics that determine the selection of fishing sites.

Table 3-1
Mean Importance Ratings (and standard errors of the mean)
of Fishing Site Characteristics
(mail survey Q3)

Species of fish	4.75 (0.083)
Number of fish	5.00 (0.066)
Size of fish	5.02 (0.069)
Catch and release stretches	4.48 (0.098)
Proximity to angler's home	3.97 (0.102)
Scenic quality	4.95 (0.076)
Avoid unattractive site	4.64 (0.084)
Fish at many sites	4.90 (0.071)
Quality of nonfishing recreation	3.72 (0.084)

Ratings: 1 = *not at all important* to 7 = *very important.*
Sample size = 491.

Rating of Sites for Catch and Other Characteristics

The above results suggest that catch rates and other site characteristics are important to the selection of a site. Questions 4 through 7 of the mail survey asked respondents to rate seven sites (Big Hole 2, Rock Creek, Madison 2, Missouri, Jefferson 2, Upper Clark Fork 4, and the combination of Upper Clark Fork 2 and 3) on the basis of:

- Familiarity with the site (from 1 = *not at all familiar* to 7 = *very familiar*)
- Perceptions about the largest fish they could expect to catch (from 1 = *below average* to 7 = *above average*)
- Perceptions about the number of fish they would expect to catch in four hours of fishing (from 1 = *below average* to 7 = *above average*)
- Perceptions about the quality of nonfishing recreation activities at the site (from 1 = *below average* to 7 = *above average*).

Anglers could also provide *Don't Know* responses to the last three site characteristics if they felt they were unfamiliar with the site.

In all four categories, the Clark Fork sites scored the lowest in terms of average angler ratings. Madison 2 ranked highest in all categories except the quality of nonfishing recreation, in which it ranked third. The high rankings for Madison 2 are consistent with prior economic value studies comparing this site to other sites (see Duffield *et al.*, 1988). The rank order of the site ratings for expected catch rates is also the same rank order as the catch rates estimated using observed data and trip behavior (see Chapter 5.0, Figure 5-1). In essence, anglers have generally accurate perceptions about the relative quality of fishing sites in Southwestern Montana. With accurate perceptions on site characteristics, and with catch being an important site characteristic, we can expect that decisions on trip-taking behavior will reflect differences in expected catch rates across different sites. See Table 3-2 for specific rating averages for all seven sites.

Expected Changes in Fishing Behavior as Catch Changes

In the subsequent analyses (Chapters 4.0 through 7.0), the recreation demand model will predict, based on current behavior, how changes in expected catch rates for trout will impact recreation behavior. The mail survey included questions to investigate what anglers state their expected behavior would be if catch rates for trout changed at selected sites (Q12 through Q21). This provides a comparison between the recreation demand model's predicted changes in behavior and how anglers state they would change their behavior in response to hypothetical changes in catch rates.

The analysis is conducted through a contingent behavior scenario where the angler is presented a change in the expected catch rate at a site and asked, as a result: how he would rate the site; how many more or fewer visits he would have taken to the site in 1992; and how many more or fewer visits he would have taken to other sites in 1992. This analysis is used to validate the predicted behavior in the recreation demand model.

Four sites were considered in the contingent behavior analysis, which included two sites in each of two survey versions: Big Hole 2 and the combination of Upper Clark Fork 2 and 3 in Version 1; and Madison 2 and Upper Clark Fork 4 in Version 2. Each survey version included a Clark Fork River site and another site so as not to communicate that the survey was exclusively focused on the Clark Fork River, but rather had a broad focus. Different anglers were asked about different changes in the level of expected catch in four hours of fishing at these sites. For example, some anglers were asked about an increase in the catch rate at Big Hole 2 of two fish per four hours while others were asked about a decrease in the catch rate at Big Hole 2 of minus four fish per four hours.

Table 3-2
Site Specific Ratings from Mail Survey*
(Q4-Q7)

	Big Hole 2		Rock Creek		Madison 2		UCF 2 and 3		UCF 4		Missouri		Jefferson 2	
	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N
Familiarity rating[1] (Q4)	3.21 (0.095)	494	2.93 (0.131)	252	3.21 (0.140)	242	2.35 (0.099)	250	2.00 (0.101)	241	2.82 (0.139)	253	2.43 (0.123)	242
Perception of largest fish[2] (Q5)	5.06 (0.077)	263	4.43 (0.134)	110	5.14 (0.105)	132	4.05 (0.156)	86	4.26 (0.182)	62	5.06 (0.149)	108	4.62 (0.132)	91
Perceived catch rate[2] (Q6)	4.66 (0.085)	264	4.83 (0.136)	107	4.92 (0.117)	134	3.72 (0.139)	85	4.03 (0.193)	68	4.55 (0.149)	107	4.32 (0.154)	92
Rating for nonfishing recreation[2] (Q7)	5.09 (0.094)	238	5.54 (0.123)	111	4.83 (0.123)	133	4.09 (0.133)	95	4.27 (0.195)	66	4.67 (0.140)	95	4.44 (0.153)	85

* Anglers were asked about four of the seven sites. Big Hole 2 appeared on both versions of the mail survey. All other sites only appeared on one version. For this reason, there are more responses for Big Hole 2. The mean ratings for Big Hole 2 do not differ significantly across survey versions.

Ratings:

[1] 1 = *unfamiliar* to 7 = *very familiar.*

[2] 1 = *below average* to 7 = *above average.*

At sites with high expected catch rates, the survey asked about changes in catch rates that included modest increases and modest to large decreases because large increases in catch may have seemed unrealistic. Increases of one, three, and five fish per four hours were considered for the Clark Fork sites (at the time of the survey design the predicted improvement in catch rates was unknown for the Clark Fork sites in the baseline, "no-injury" condition). Results for the contingent behavior analysis are reported in Tables 3-3 and 3-4.

Respondents were presented the change in expected catch for trout and then asked to rate the expected catch at the site, which can be compared to their earlier rating of the site in Question 6. Respondents generally rated the site higher if the catch rate increased, and lower if the catch rate decreased.

Respondents also generally indicated they would have taken more trips to a site if the catch rate had increased, and they would have taken fewer visits if the catch rate had decreased. For some respondents, the change in catch rates would not have changed their fishing behavior. For example, respondents who live far from a site might not have taken any additional trips to a site in 1992 if the catch rate had increased at the site. The results vary depending on the site and the change in catch rates that is considered. Overall, for an increase of one to two trout per four hours of fishing, respondents indicated they would have taken one-half to one more trips to the site per year and between zero and 0.4 fewer trips to other sites. This indicates that of the additional trips that would be taken to a site with enhanced catch, some would be new fishing trips and some would be trips substituted from other fishing locations.

Generally, anglers who had previously visited a site in 1992 were more responsive to the proposed change in expected catch at that site than were other anglers. For example, anglers who had visited Clark Fork 2 or 3 in 1992 would increase their trips to the site under the improved catch conditions more than anglers who had not visited the site in 1992. This may reflect both familiarity with the site leading to more responsiveness, and that individuals closer to the site are more likely to have visited the site and are more likely to increase their visits to the site if the catch rates at the site improve.

In Chapter 7.0 the contingent behavior results are used in two ways. First, they are used as a means to examine whether the recreation demand model predictions for changes in visits to the impacted sites under baseline conditions are consistent with stated intentions. Second, the results can be combined with recreational fishing valuation literature to apply a unit value damage assessment methodology [43 CFR § 11.83 (d)(6) and Proposed 43 CFR § 11.83 (c)(2)(ii)(E)].

Target Species and Respondent Comments

In the mail survey (Q11) respondents were asked to identify the fish species they were targeting on a recent trip. Over 74 percent of all anglers indicated they were fishing for

Table 3-3
Results from Contingent Behavior Questions on Mail Survey:
Clark Fork River Sites*
(Q12-Q15)

Changes in Catch Rate per Four Hours Fishing	Clark Fork 2 & 3 Version 1 Mean (standard error of mean) Number of Observations			Clark Fork 4 Version 2 Mean (standard error of mean) Number of Observations		
	+1	+3	+5	+1	+3	+5
Rating of current expected catch (Q6)	3.78 (0.260) N=19	3.86 (0.295) N=21	3.45 (0.294) N=20	4.52 (0.370) N=19	4.13 (0.467) N=15	3.79 (0.355) N=19
Rating of expected catch after change (Q13)	3.68 (0.325) N=19	4.67 (0.303) N=21	4.80 (0.427) N=20	4.21 (0.311) N=19	5.07 (0.442) N=15	5.11 (0.366) N=19
Difference in average number of trips to this site after change (Q14) for:						
All respondents	1.07 (0.253) N=29	1.31 (0.299) N=39	2.43 (1.487) N=40	0.58 (0.151) N=36	1.64 (0.321) N=25	1.68 (0.588) N=34
Those who had positive number of trips to site before change (using Q12 response)	1.57 (0.649) N=7	2.50 (0.946) N=10	8.50 (7.368) N=8	2.00 (0.577) N=3	3.00 (0.816) N=7	2.33 (0.558) N=6
Difference in average number of trips to other sites after change (Q15) for:						
All respondents	-0.27 (0.126) N=30	-0.11 (0.259) N=37	-0.24 (0.125) N=46	0.00 (0.104) N=31	-0.41 (0.219) N=29	-0.39 (0.137) N=31
Those who had positive number of trips to site before change (using Q12 response)	-0.50 (0.327) N=8	-1.00 (0.681) N=8	0.10 (0.348) N=10	0.25 (0.629) N=4	-0.88 (0.742) N=8	-0.83 (0.401) N=6

* Each column represents results from a different subset of respondents.

Ratings: 1 = *below average* to 7 = *above average.*

Table 3-4
Results from Contingent Behavior Questions on Mail Survey:
Big Hole and Madison*
(Q17-Q20)

Changes in Catch Rate per Four Hours Fishing	Big Hole 2 Version 1 Mean (standard error of mean) Number of Observations			Madison 2 Version 2 Mean (standard error of mean) Number of Observations		
	-4	-2	+2	-4	-2	+2
Rating of current expected catch (Q6)	4.86 (0.236) N=35	4.72 (0.231) N=36	4.48 (0.227) N=33	4.80 (0.191) N=35	5.49 (0.194) N=35	5.03 (0.221) N=37
Rating of expected catch after change (Q13)	3.40 (0.253) N=35	3.42 (0.265) N=36	5.09 (0.259) N=33	2.43 (0.214) N=35	3.91 (0.291) N=35	5.54 (0.196) N=37
Difference in average number of trips to this site after change (Q19) for:						
All respondents	-0.42 (0.124) N=42	-0.38 (0.219) N=32	0.74 (0.191) N=34	-0.66 (0.220) N=41	-0.19 (0.185) N=37	0.53 (0.141) N=24
Those who had positive number of trips to site before change (using Q17 response)	-0.48 (0.162) N=29	-0.65 (0.310) N=20	0.68 (0.287) N=19	-0.96 (0.318) N=25	-0.24 (0.323) N=21	0.67 (0.187) N=24
Difference in average number of trips to other sites after change (Q20) for:						
All respondents	0.09 (0.095) N=47	0.06 (0.091) N=35	-0.40 (0.141) N=42	0.74 (0.200) N=39	0.33 (0.138) N=36	-0.07 (0.146) N=41
Those who had positive number of trips to site before change (using Q17 response)	0.04 (0.040) N=25	0.06 (0.171) N=18	-0.05 (0.259) N=18	0.91 (0.286) N=22	0.53 (0.259) N=17	-0.23 (0.227) N=22

* Each column represents results for a different subset of respondents.

Ratings: 1 = *below average* to 7 = *above average.*

trout species, 9 percent had no preference, and 17 percent were fishing for other species. This clearly indicates that trout are the predominate species targeted at Southwestern Montana rivers and streams.

The written comments on the mail survey (Q8 and final comments on the survey) also indicate that catch characteristics, and catch rates in particular, are important to anglers. These comments are summarized in Table 3A-5. The largest share of the comments deal with catch limits, catch and release, and stocking of fish.

3.2 OBSERVED CATCH RATES

Individual catch rates are measured as the number of trout caught per hour. Each individual intercepted was asked to provide the time he or she began fishing at the intercept site (Q4 on the intercept survey) and the number of trout caught up to that time (Q5 on the intercept survey). Individual catch rates were computed by dividing the number of trout caught by an individual by the total amount of time spent fishing in hours. Not all of the 1,951 intercepted anglers reported individual catch rates because some of them had not begun fishing at the time of the survey. Additionally, individual catch rates are only computed for anglers who had fished for more than five minutes.[1] A total of 1,380 individual catch rates were calculated for our 26 sites. Of those individual catch rates, almost half are zero. The largest individual catch rate is 24 fish per hour, which was reported at Madison 2.

There are fewer observed individual catch rates at the sites receiving lower perceived catch rate ratings than at the sites receiving higher perceived catch rate ratings (Q6 on mail survey). For example, Madison 2 was given the highest average perceived catch rate rating, and there are 176 observations on catch rates at that site. Upper Clark Fork 2 and 3 received the lowest rating, and there are only 30 individual catch rates from those two sites. The disparity in numbers of individual catch rates is another indication that anglers take fewer trips to sites that have lower perceived catch rates.

3.3 TRIP PATTERNS AND CHARACTERISTICS

The data indicate many factors contribute to where and how often anglers fish. This section describes the trip patterns and trip characteristics of anglers visiting Southwestern Montana and the relationships between those trip patterns and angler characteristics. Trip records were compiled from responses on the intercept survey, the telephone survey, and the mail survey.

[1] The group who had been fishing for less than five minutes when intercepted could include unrealistically enormous individual catch rates because a few anglers caught fish only moments after they began fishing. There are 30 individuals in this group.

The mail survey was completed by 505 anglers, and an additional 8 anglers participated in the telephone follow-up to the mail survey. Thus, we have complete trip records for 513 anglers. Both residents and nonresidents were asked if the primary purpose of the intercept trip was to fish (Q3 on the intercept survey). If the trip was primarily to do something other than fish, data on the intercept trip were omitted from the trip record. If the intercept trip was the only trip in the trip record, the angler was omitted from the data set. Nonresidents were asked if the primary purpose of their most recent trip was to fish (Q34 on the mail survey). If fishing was not the primary purpose, the nonresident angler was dropped completely from the data. It would have been better to identify which trip in the trip record was associated with Q34. However, it was not always possible to make such an association, so any nonresidents who responded *no* to Q34 on the mail survey were omitted. We wanted to retain anglers whose main reason for taking fishing trips was to fish because that is the activity the recreation demand model is designed to explain. However, more joint-purpose trips may be taken if fishing is improved.

By following the above rules about whether a trip was primarily to fish, two percent of resident anglers and one percent of all resident fishing trips were omitted from the data (i.e., the model includes data only on fishing trips, rather than joint purpose trips for residents). Thirty percent of nonresidents and twenty-four percent of nonresident fishing trips were dropped from the data.

The final sample consists of 443 individuals composed of 291 residents and 152 nonresidents. Unless otherwise indicated, the following discussions apply to the final sample of 443 anglers.

Total Number of Trips, Trip Proportions, and Determinants of the Total Number of Trips

The average number of trips taken to rivers and streams in Montana from May through September 1992 is 13.05 for the study sample.[2] The median is seven trips. The mean is larger than the median because a few anglers took a large number of trips, which significantly increases the average. From the trip records, we can conclude that approximately 73 percent of all resident trips and 82 percent of all nonresident trips to Southwestern Montana were to one of the 26 intensively studied sites. A comparison of the average number of trips for the study sample versus other studies is discussed in Chapter 7.0.

[2] Our sample took most of their trips in Southwestern Montana. Only seven percent of all trips for which specific trip destination information was reported were taken outside of the four regions depicted in Figure 2-1.

The six most popular of the 26 intensively studied sites in terms of visitation are Rock Creek, Bitterroot 2, both Big Hole sites, Missouri, and Madison 2. They account for 52 percent of all the trips to the 26 sites. The five upper Clark Fork sites and Silver Bow Creek account for only 6 percent of all of the fishing trips to the 26 sites. See Table 3-5 for sample proportions of trips to each of the 26 sites for the full sample, residents, nonresidents, residents of Missoula, and residents of Bozeman (proportions may not sum to 100 percent due to rounding).

Note that Beaverhead and Madison 2 are relatively more popular among nonresidents while the Bitterroot sites are more popular among residents. The data also show that both Missoula and Bozeman residents take the majority of their trips to rivers and streams in their home regions.

The data suggest distance to a site explains in part how many trips an angler takes. The sample mean number of trips for residents from May through September 1992 is 17.87, and the median is 13. The mean number of trips for nonresidents is 3.81, and the median is 2. Additionally, of the total 1,951 anglers who were intercepted, 63 percent were residents. Nonresidents take far fewer trips than residents, indicating distance and its relationship to costs play a strong role in determining the number of trips an individual takes.[3]

The data also indicate gender is an important factor in the determination of the total number of trips. Of the 443 members of the final sample, 402 are male. Almost 90 percent of all of the intercepted anglers are male. Males on average take 13.5 trips while females on average take only 8.1 trips.

Data on many other variables that characterize the anglers in the sample were collected and include age, wage rate, income, weeks of paid vacation, years fished in Montana, free time on a typical weekday,[4] and self-assessed angler skill rating. The median age for all anglers in the sample is 38. The average hourly wage for residents is $15.67 and for nonresidents is $27.94. The average 1991 pretax income for residents is $41,006 and for nonresidents is $81,672. The wage and income statistics indicate nonresident anglers are on average much wealthier than resident anglers. The average angler has 1.6 weeks of paid vacation per year. The average resident has fished for over 18 years in Montana while the average nonresident has fished for 9 years in Montana. The average angler has almost seven hours of free time on an average summer weekday. On a scale from 1 to 7, with 1 being *novice* and 7 being *expert*, the average angler rates himself around 4.8 (average self-assessed skill ratings do not differ substantially for residents and

[3] See Table 3A-6 for more statistics on the number of trips taken by the full sample and subgroups of the full sample.

[4] Free time is calculated as the hours in a day left after sleeping, working for wages, child care, housekeeping, and studying.

Table 3-5
Proportion of Trips to Intensively Studied Sites: May-September 1992

River	Full Sample	Residents	Nonresidents	Missoula Residents	Bozeman Residents
UCF 1	0.026	0.029	0.006	0.103	0.000
UCF 2	0.011	0.013	0.000	0.041	0.000
UCF 3	0.004	0.004	0.000	0.028	0.000
Middle CF	0.049	0.057	0.000	0.290	0.000
Rock Cr.	0.065	0.060	0.097	0.207	0.012
Flint Cr.	0.013	0.013	0.013	0.007	0.000
Bitterroot 1	0.038	0.044	0.000	0.076	0.000
Bitterroot 2	0.074	0.081	0.032	0.041	0.000
Lolo Cr.	0.012	0.014	0.000	0.028	0.000
Blackfoot	0.026	0.029	0.006	0.117	0.000
L. Blackfoot	0.017	0.019	0.000	0.000	0.000
UCF 4	0.007	0.007	0.006	0.000	0.000
UCF 5	0.015	0.017	0.000	0.000	0.000
Silver Bow Cr.	0.001	0.001	0.000	0.000	0.000
WSC	0.003	0.003	0.000	0.000	0.000
Big Hole 1	0.057	0.058	0.052	0.000	0.006
Big Hole 2	0.061	0.064	0.045	0.000	0.030
Jefferson 2	0.038	0.043	0.006	0.007	0.000
Beaverhead	0.049	0.039	0.116	0.000	0.012
Jefferson 1	0.017	0.019	0.000	0.000	0.006
Missouri	0.145	0.149	0.123	0.041	0.018
Yellowstone	0.038	0.039	0.032	0.000	0.115
Gallatin	0.040	0.040	0.045	0.000	0.170
E. Gallatin	0.024	0.026	0.006	0.000	0.133
Madison 1	0.058	0.064	0.019	0.000	0.285
Madison 2	0.113	0.069	0.394	0.014	0.212

nonresidents). All of these variables proved to be important factors in the participation decision on how often to fish in Montana (see Chapter 5.0).

Data for anglers in the sample who did not complete the mail survey were not included in the final data set because the trip records for these anglers are incomplete. No apparent bias is introduced by excluding anglers in the sample who did not complete the mail survey, as those in the follow-up group who completed the mail survey do not differ substantially from nonrespondents in terms of the total number of trips they take. Respondents took an average of 8.8 trips before they responded to the mail survey while nonrespondents took an average of 7.9 trips before the mail survey.

Trip Duration

Nonresidents spend more time at a site when they come to fish than do residents. Residents spent an average of 4.9 hours on-site during the intercept trip, whereas nonresidents spent an average of 13.1 hours. Also, residents visiting an intercept site closer to their home spend less time on-site than do residents visiting an intercept site farther from their home. Trip duration plays an important role in the determination of trip costs discussed in Chapter 5.0. Characteristics of trip duration are presented in Table 3-6.

Trip Costs

As might be expected, nonresidents report higher expenses for lodging and equipment for the intercept trip than do residents. The average equipment and lodging expenses for nonresidents are $413.67 per trip, whereas the average expenses for residents are $25.58 per trip. Also, average intercept-trip lodging and equipment expenses are greater for residents visiting sites farther away from their home than for residents visiting nearby sites. Equipment and lodging expenses are presented in Table 3-7.

Destinations and the Sizes of Rivers and Streams

Larger rivers and streams attract more anglers than smaller rivers and streams. A size index for all 26 sites chosen for intensive study was created by multiplying the length of the segment by the average flow in cubic feet per second.[5] Flow was not used by itself because length varies greatly over these sites. The shortest site is 2 miles long and the longest is 30 miles long. The largest seven sites account for 42.6 percent of all trips to the 26 intensively studied sites. The smallest seven account for only 13.4 percent.[6] The site sizes are reported in Table 3-8.

[5] Because flow data for 1992 were unavailable, average flows from May through August 1991 were used (U.S. DOI, 1991).

[6] See Table 3A-7 for proportions of trips to each site compared to the size of the sites.

Table 3-6
Trip Duration Characteristics

	Variable	Number of Observations	Mean (standard error of mean)	Mean for Those Who Did Not Visit Another River Site Before Intercept	Mean for Those Who Visited Another Site Before Intercept
Trip Duration Characteristics for Full Sample and by Residence Status					
Full sample	Hours at site	1,850	7.90 (0.289)	6.87	11.03
	Nights on trip	1,855	5.76 (0.315) [median=1]	3.48	12.46
Nonresident	Hours at site	683	13.05 (0.666)	13.00	13.10
	Nights on trip	697	13.20 (0.711) [median=8]	10.97	15.50
Resident	Hours at site	1,167	4.88 (0.191)	4.81	5.46
	Nights on trip	1,158	1.27 (0.159) [median=0]	0.91	4.26
Trip Duration Characteristics for Residents by Distance from Residence					
0-25 miles	Hours at site	579	3.53 (0.097)	3.56	3.22
	Nights on trip	572	0.22 (0.047)	0.21	0.35
26-50 miles	Hours at site	176	6.55 (0.659)	6.25	10.38
	Nights on trip	174	1.17 (0.404)	0.96	4.27
51-150 miles	Hours at site	149	6.15 (0.655)	6.60	4.25
	Nights on trip	148	1.43 (0.176)	1.39	1.59
> 150 miles	Hours at site	70	8.70 (1.482)	8.20	10.73
	Nights on trip	73	3.75 (0.572)	3.31	5.47

Table 3-7
Mean Lodging and Equipment Expenses for Intercept Trip

	Mean Lodging Expense (standard error of mean)	Number of Observations	Mean Equipment Expense (standard error of mean)	Number of Observations
Average Expenses by Residence Status				
Residents	$6.54 (2.097)	978	$19.04 (4.735)	1171
Nonresidents	$220.89 (20.961)	689	$192.78 (20.747)	701
Average Expenses for Residents by Distance of Residence from Intercept Site				
0-25 miles	$0.12 (0.059)	425	$10.40 (4.661)	588
26-50 miles	$6.29 (5.887)	170	$10.25 (2.109)	178
51-150 miles	$3.46 (1.216)	141	$9.78 (3.026)	149
> 150 miles	$33.49 (11.045)	72	$22.63 (8.775)	72

Table 3-8
Sizes of 26 Intensively Studied Sites

River	Flow (CFS) Average May - August	Length* (miles)	Size (flow x length)
Middle CF	5,007	25	125,175
Yellowstone	8,333	14	116,662
Bitterroot 1	2,799	25	69,975
Blackfoot	3,397	19	64,543
Missouri	5,479	9	49,311
Jefferson 1	2,459	19	46,721
Jefferson 2	2,459	19	46,721
Madison 2	1,595	29	46,255
Big Hole 1	1,929	21	40,509
Gallatin	1,954	17	33,218
Bitterroot 2	1,487	22	32,714
UCF 1	1,673	19	31,787
Big Hole 2	1,929	13	25,077
Rock Cr.	885	24	21,240
Madison 1	2,024	9	18,216
UCF 2	554	26	14,404
UCF 3	554	19	10,526
Beaverhead	585	12	7,020
UCF 4	228	30	6,840
L. Blackfoot	202	15	3,030
Lolo Cr.	100	24	2,400
Silver Bow Cr.	63	18	1,134
E. Gallatin	160	7	1,120
Flint Cr.	94	10	940
WSC	70	7	490
UCF 5	228	2	456

* Site lengths for all 26 sites were estimated using a map measuring wheel. All of these lengths can be expected to be less than true river mile lengths because such an instrument cannot capture all river meanders.

4.0 A RECREATION DEMAND MODEL THAT ESTIMATES PARTICIPATION, SITE CHOICE, AND EXPECTED CATCH RATES

A statistical recreation demand model was developed that predicts the number of fishing trips (participation) to rivers and streams in Montana for our sample of 443 anglers. This model also predicts the allocation of those trips among rivers and streams (site choice). Damage estimates are derived from this model.

The model is individual based; it predicts the number of fishing trips and site choices for an individual angler as a function of his or her characteristics and as a function of expected catch rates. Total predicted trips for the sample and population are derived by summing over anglers.

Demand for trips is modeled for all of the rivers and streams in Montana, but not all of the rivers and streams are modeled in the same way. As discussed in Chapters 2.0 and 3.0, 26 river sites in Southwestern Montana were chosen for intensive study, and specific trip and catch data were collected for each of these sites. This group of 26 sites represents a cross section of the rivers and streams in Southwestern Montana in terms of size, geographical dispersion, and perceived catch rates. The group includes all of the impacted sites in the Clark Fork River Basin (Clark Fork 1-5 and Silver Bow Creek) and accounts for 73 percent of the river and stream trips to Southwestern Montana for residents and 84 percent for nonresidents. Montana was divided into five regions: four in Southwestern Montana (Missoula, Butte, Helena, and Bozeman), and one for all trips to Montana rivers and streams outside of Southwestern Montana. If a trip was not to one of the 26 sites, the trip was modeled as a trip to a collective site designated *other* in the site's region.

Once the parameters of the model were estimated using a computer, the results were used to predict what individual trip patterns would be if the expected catch rates for trout in the upper Clark Fork River Basin were at baseline levels. See Chapter 5.0 for details about estimation and Chapter 7.0 for details about using the model to predict trip-taking behavior under baseline conditions.

4.1 THE MODEL HAS TWO INTERCONNECTED COMPONENTS: A TRAVEL-COST COMPONENT AND A CATCH RATE COMPONENT

The *travel-cost component* of the recreation demand model predicts where and how often each angler in the sample will fish in Southwestern Montana as a function of the expected catch rate at each of 26 sites, the angler's trip costs to each of 26 sites, the angler's income, and other important demographic characteristics of the angler such as age, gender, and residency.

The *catch rate component* of the model estimates the expected catch rates at the 26 sites as a function of observed catch rates at each site and as a function of how anglers allocate their trips among the sites.[1] If the demand for trips and choice of sites were not a function of expected catch rates, the best estimate of the expected catch rate at each site would be the average of each site's observed catch rates. However, demand for trips and sites is a function of expected catch rates. Anglers can be expected to visit sites with higher expected catch rates more often than sites with lower expected catch rates. Therefore, sites with higher expected catch rates have more observed catch rates reported by individual anglers than sites with lower expected catch rates. Because demand for fishing is a function of expected catch rates, observed trip patterns provide significant information with which to predict expected catch rates. The best estimates of expected catch rates are those estimates that jointly best explain observed catch rates and observed trip patterns.

The two components of the model are linked by expected catch rates: trip patterns are a function of expected catch rates, and observed trip patterns provide information that can be used to estimate expected catch rates. Because of this linkage, the two components of the model were jointly estimated. Observed trip patterns and catch rates were used to estimate expected catch rates in the catch rate component, and simultaneously, trip patterns were predicted as a function of expected catch rates and other variables such as trip costs in the travel-cost component.

4.2 THE JOINT MODEL OF PARTICIPATION, SITE CHOICE, AND EXPECTED CATCH RATES

The time span modeled is May through September. While trips occur in other months, the large majority of trips occur in this period (McFarland, 1989).[2] Because trips occur from October to May and because trip patterns in this off-season will also be impacted by the injuries to the upper Clark Fork River Basin, our estimates of damages will be biased downward in comparison to annual damages. This downward bias is corrected when computing aggregate annual damages, which include winter damages, in Chapter 9.0.

We assume the fishing season consists of sixty periods such that in each period an angler takes no more than one fishing trip. There is no stipulation that each period is of equal length; 60 periods were chosen because only 10 anglers in our sample took more than 60

[1] Recall that the expected catch rate at a site is what the average angler expects to catch on an average day at the site and cannot be observed.

[2] See Chapters 2.0, 7.0, and 9.0 for more discussion of this issue.

trips.[3] The individual simultaneously decides both whether to fish at a river or stream in Montana and, if so, which one. The angler has 31 fishing sites from which to choose: 26 specific sites and 5 *other* sites.[4] In each period, each angler must choose one of 32 alternatives where one of the alternatives is nonparticipation.[5] The angler's decision tree for each period is represented by Figure 4-1 (see Table 2-1 for the full names of sites). The sites are grouped by regions that correspond to the major cities in Southwestern Montana because anglers are more likely to visit sites near their homes.

This recreation demand model determines the per-period probability that individual i will choose alternative j. The predicted number of trips angler i will take to site j is therefore the per-period probability that individual i will choose site j multiplied by 60, and the predicted number of trips angler i will take to all sites in Montana during the summer season is the sum of his or her predicted trips to the 31 sites.

4.2.1 The Angler's Per-Period Probability of Choosing Alternative j: The Travel-Cost Component

The angler's per-period probability of choosing alternative j is a function of the following variables:

1. *Trip costs for each of the sites.* The number of trips an individual takes is a decreasing function of the relative cost of fishing trips; i.e., as fishing becomes more expensive, everything else constant, the angler will take fewer trips. In addition, given the decision to take a trip, the choice of sites depends on the relative costs of trips to the different sites; i.e., sites with low trip costs are visited more often than sites with high trip costs.

2. *The expected catch rates at each of the sites.* The expected catch rates affect demand in two ways: with higher expected catch rates, anglers will take more trips overall, and anglers visit sites with higher expected catch rates more often than sites with lower expected catch rates.

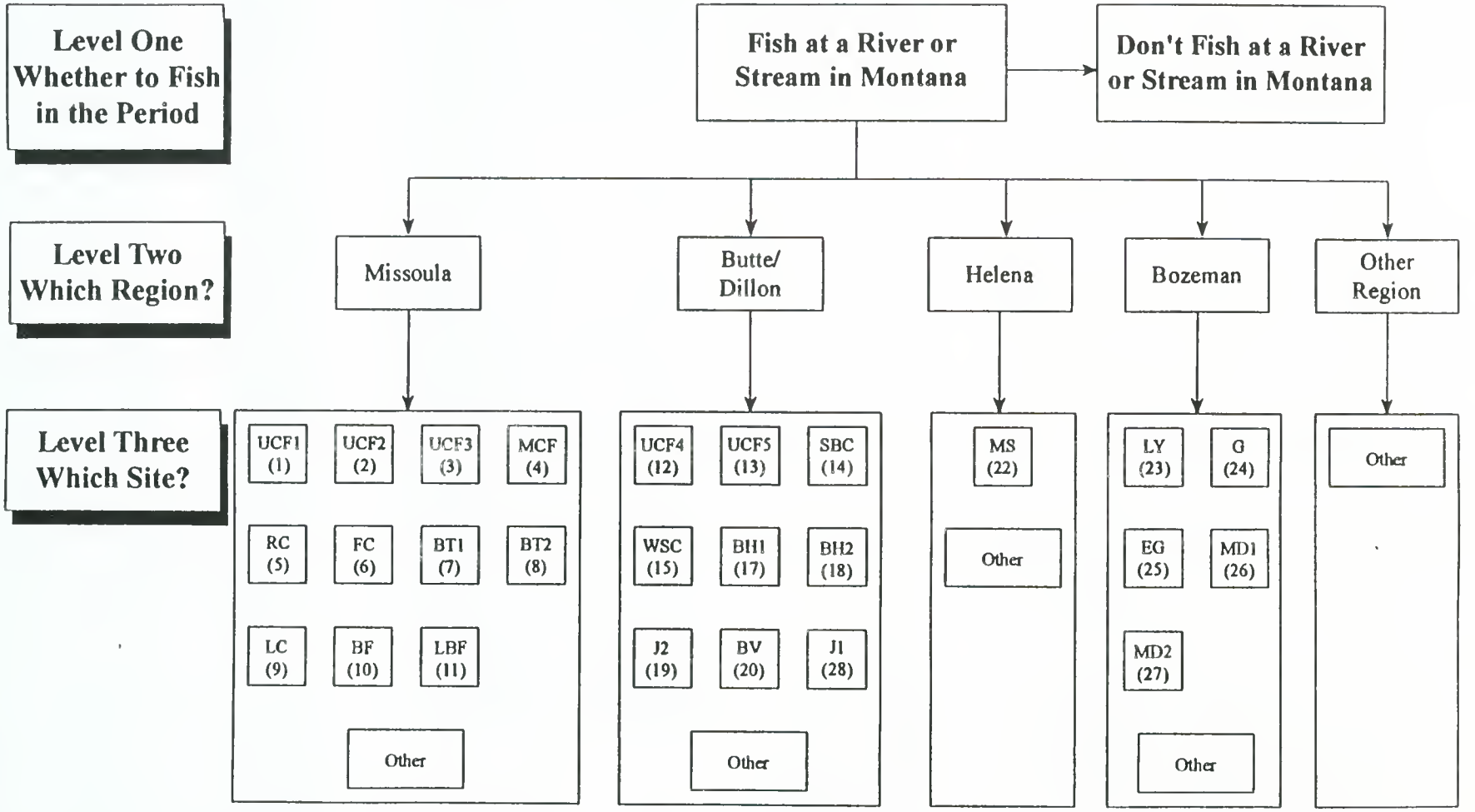
---

[3] The assumption that the season can be modelled as consisting of N periods where in each period an angler can take at most one trip is a simplifying assumption adopted from Morey *et al.* (1991) and Morey *et al.* (1993). While the assumption is not literally true, it is a proven modeling device for predicting total trips and site choices. Note that truncating the maximum number of trips to 60 will cause the estimates of both total trips and damages to be biased downward.

[4] The five *other* sites are composed of one *other* site for each of the four regions in Southwestern Montana, and a fifth *other* "catch-all" site for all trips to Montana rivers and streams outside of Southwestern Montana.

[5] Nonparticipation includes fishing at sites, such as lakes, that are not rivers or streams.

Figure 4-1
Each Angler's Decision Tree for Each Period*



* Numbers in parentheses correspond to site numbers in Table 2-1.

3. *The size of the fishing sites.* With everything else constant, anglers will take more trips to large sites than to small sites.[6]

In addition, an angler's participation rate and site choice is also a function of the following seven demographic characteristics of the angler: income, gender, reported fishing skill, years fished in Montana, weeks of paid vacation, reported free time for a typical weekday, and whether the angler is a resident of Montana. The detailed recreation demand model is described in Appendix 4A.

4.2.2 The Catch Rate Component

The intent of this component of the model is to derive the best estimate of each site's expected catch rate. Two different types of information were collected that can be used to derive best statistical estimates of the expected catch rates:

Actual trout catch was recorded for each angler intercepted, and these data were converted into per-hour observed individual catch rates by dividing by the number of hours the individual fished. The number of observed individual catch rates for a site is an increasing function of the popularity of the site, so popular sites have many observed catch rates and unpopular sites have only a few, even though approximately the same amount of time was spent interviewing at each of the 26 intensively studied sites (except Silver Bow Creek which received about 55 percent of the interviewing time received by other sites; see Duffield *et al.*, 1992a). The number of observations on catch rates varies from 0 at Silver Bow Creek to 176 at Madison 2.

Trip patterns were recorded for all of the anglers followed-up, and observed trip patterns can be used to provide additional information to estimate expected catch rates. As noted above, anglers take more trips to sites with higher expected catch rates and fewer trips to sites with lower expected catch rates. If one had data on individual catch rates but no data on trip patterns, the best statistical estimate of a site's expected catch rate would be the average of the observed individual catch rates for that site. Alternatively, if one had data on trip patterns but no data on individual catch rates, the best statistical estimates of expected catch rates would be those estimates that, along with trip costs, site sizes, and demographic variables, best explain the collective trip patterns of all anglers in the sample.

[6] A site's size is defined as the site's average flow from May through August (in CFS) multiplied by the site's length (in miles — see Table 3-8). Sizes of the sites are important determinants of both the total number of fishing trips to Southwestern Montana and which sites are chosen because, everything else constant, larger sites have more access points and more places to fish.

Since data are available on both individual observed catch rates and individual trip patterns, the best statistical estimate of a site's expected catch rate is a weighted average of these two separate estimates, where the weight on a site's average observed catch rate is an increasing function of the number of observed catch rates at the site. Such a weighting is critical because if the average of a site's observed catch rates is based on a large number of observations (a popular site), the average observed catch rate is likely to be a good estimate of the site's expected catch rate, but the average observed catch rate is less likely to provide a good estimate of a site's expected catch rate if it is only based on a few observations.

4.3 USE OF THE RECREATION DEMAND MODEL

Chapter 5.0 presents the computer-estimated parameters of the recreation demand model and discusses the model's ability to explain observed trip patterns. The model can predict how many trips an angler will take and to where as a function of any set of expected catch rates. Expected catch rates for the baseline scenario are presented in Chapter 6.0. The model is used in Chapter 7.0 to predict how many trips would have been taken and to where, during the summer season of 1992, if there had been no injuries to the Clark Fork River Basin. This is accomplished by replacing expected catch rates at the impacted sites with the expected catch rates that would have existed if there had been no injuries.

5.0 IMPLEMENTATION AND ESTIMATION OF THE RECREATION DEMAND MODEL OF PARTICIPATION, SITE CHOICE, AND EXPECTED CATCH RATES

5.1 EMPIRICAL IMPLEMENTATION OF THE RECREATION DEMAND MODEL

This section describes and explains the construction of trip costs to each site for each angler and the concept of and construction of *full income* for each angler, which are required to implement the model.

A Representative Sample of Anglers

The sample of anglers used in the recreation demand model is composed of 443 residents and nonresidents for whom we have trip records for the entire 1992 summer season (see Section 3.3). The sample is composed of licensed anglers from cities and towns widely distributed over Montana, the rest of the United States, and Canada.

The Cost of a Trip to Site j for Individual i

The recreation demand model requires not only trip records for each individual in the sample but also data on the characteristics of each angler, data on trip costs to each site for each individual, and data on site characteristics. The cost of a trip to site j has four components: transportation costs, lodging costs, equipment costs, and the opportunity cost of the individual's time in travel and while at the site. For a given individual, trip costs vary across sites as a function of the distance of the sites from the angler's residence. For a given site, trip costs vary across individuals as a function of how far they reside from the site and the opportunity cost of their time. Using several assumptions, which are described below, trip costs to each of the 26 intensively studied sites were calculated for each of the 443 individuals.

The cost of a trip to site j by individual i is not his or her reported trip expenses for site j (because anglers do not visit all sites), but is instead the expected costs to visit a site. The amount an angler would be expected to spend on a typical trip to site j depends on that angler's characteristics. Trip cost is determined by the distance to the site, the angler's wage rate, average equipment and lodging costs by one-way distance category (0-25 miles, 26-50 miles, 51-150 miles, and more than 150 miles), and average on-site time by distance category. Distance and per-mile vehicle operating costs were used to determine transportation costs for residents and all nonresidents for whom driving was less expensive than flying, and airfares and car rental rates were used to calculate transportation costs for distant nonresidents. See Appendix 5A for further details on the calculation of trip costs.

Trip costs vary significantly across sites for each resident angler, but do not vary significantly across sites for each nonresident, because for most nonresidents all of the sites are effectively the same distance from each individual's home. For residents, the sum of a trip's expected money costs for transportation, lodging, and equipment ranges from $10.52 for a trip to Silver Bow Creek by a resident of Butte to $296.47 for a trip to Bitterroot 2 by an individual who lives in Billings. For nonresidents, the sum of a trip's money costs for transportation, lodging, and equipment ranges from $517.07 to $1,086.17. Trip time, which includes round trip travel time and on-site time, varies from about three and a half hours for a trip to Silver Bow Creek from Butte to around 53 hours for an automobile trip from New Mexico to any of the sites in Southwestern Montana. On-site time was assumed to be the average reported on-site time by distance category. For example, the average on-site time for sites between 51 and 150 miles of a resident's home is about six hours. The amount of time an individual spends at a site is an increasing function of the distance to the site (see Table 3-6).

Table 5-1 uses an angler from Butte to demonstrate how trip time and money costs vary across sites for six sites ordered by distance from Butte: Upper Clark Fork 5, Jefferson 2, Upper Clark Fork 2, Madison 2, Missouri, and Big Hole 2. Both money costs and trip time increase with distance.

Time costs are converted to money costs by multiplying travel and on-site time by the opportunity cost of the individual's free time. Each individual could have added more hours at his or her current job or substituted a part-time job for his or her free time, so one of the costs of a trip is lost potential income. The per-hour opportunity cost of the individual's free time is assumed to be some fraction, β_w, of the individual's wage rate, which was estimated by the recreation demand model. The value estimated by the recreation demand model of β_w is 0.6.[1]

Other angler characteristics included in the recreation demand model are gender, residence status, amount of free time on a typical weekday, self-assessed skill level, weeks of paid vacation in a year, years fished in Montana, age, and money income. All of these data were collected by the intercept and mail surveys and are discussed in Chapter 3.0.[2]

---

[1] $\beta w = 0.6$ was estimated when all travel costs for each trip were allocated to one angler. The model was also estimated with travel costs split by two individuals (or equivalently, with the travel costs per mile at one-half the estimated amount for the angler), and β_w was estimated at 0.9. The average and aggregate consumer's surplus estimates, reported in Chapters 7.0 and 9.0, were essentially unchanged. Therefore, to the degree that travel costs are misrepresented, if at all, the β_w coefficient compensates to provide an estimate of money and time costs that best explains behavior.

[2] Missing values for the variables were substituted with averages by gender or resident groupings so that values are present for all variables for all 443 anglers. Eighty-seven percent of anglers have no missing values.

Table 5-1
Money Costs (lodging, equipment, and transportation costs) and Trip Time for a Resident of Butte

River	Money Cost	Trip Time* (hours)	One-Way Distance (miles)	River	Money Cost	Trip Time* (hours)	One-Way Distance (miles)
UCF 5	$21.52	4.42	20	Madison 2	$62.74	10.15	90
Jefferson 2	$24.27	4.64	25	Missouri	$64.94	10.33	94
UCF 2	$49.54	9.08	66	Big Hole 2	$75.94	11.22	114

* Trip time includes round trip travel time and on-site time.

Income in the recreation demand model is defined as *full income,* where full income is reported money income plus the opportunity cost of the individual's free time available for recreation or additional work (see Appendix 5A).

Size of each site and the individual catch rate observations are also inputs into the model. These data are discussed in Chapter 3.0.

5.2 ESTIMATION OF THE TRAVEL-COST AND CATCH RATE COMPONENTS OF THE RECREATION DEMAND MODEL

Statistical estimation of the model required finding those values of the model's parameters that simultaneously best explain the number of fishing trips, site choices, and observed catch rates (the likelihood function and other details are provided in Appendix 5B). There are 53 parameters in the model: 25 expected catch rates; 2 parameters that determine the influence of the expected catch rates on site choice; 5 parameters that determine the influence of trip costs and income; 5 regional parameters that help determine the allocation of trips between the 5 regions of Montana; 4 parameters that help determine trips to the collective sites in the four regions of Southwestern Montana; 3 parameters that configure statistical properties of the model; 1 parameter that helps determine how many trips anglers take; and 1 parameter each that determines the influence of each of the following 8 variables: site size, gender, age, fishing skill, years fished in Montana, free time, weeks of vacation, and residency. A statistical computer package, called *Gaussi*, was used to estimate values for the 53 parameters that maximize the likelihood that the trip patterns and catch rates (observed in the actual data) were generated by the recreation demand model. The estimates are called Maximum Likelihood estimates.

The model explains well both the numbers of fishing trips and the choice of sites. A simple *goodness-of-fit* statistic indicates the estimated model is explaining a significant proportion of the variation in the observed pattern of site visitation. Both travel costs and expected catch rates are statistically significant determinants of where and how often anglers fish.

The detailed coefficient estimates for the recreation demand model are in Table 5C-1 in Appendix 5C. The estimated influence of modeled variables on the predicted number of trips and predicted site choices can be summarized as follows. Anglers who face higher trip costs take fewer trips, and when they do take a trip, everything else constant, they prefer sites with relatively low trip costs. However, anglers will often incur higher costs to obtain a higher expected catch rate. Anglers take more trips to sites with high catch rates than to sites with low catch rates. In addition, an increase in expected catch rates would cause an angler to increase his or her total number of trips by a small but significant amount. Anglers prefer larger sites to smaller sites. Males take significantly more trips than females, and not surprisingly, residents fish more often in Montana than nonresidents. The number of trips an angler takes is an increasing function of his or her self-assessed skill level and reported hours of free time in a typical summer weekday. The number of trips an angler takes is a decreasing function of his or her age, years fished in Montana, and weeks of paid vacation.

5.3 FISHING TRIPS AND TRIP PATTERNS

5.3.1 Actual and Estimated Number of Fishing Trips to Rivers and Streams in Montana

One important gauge of how well the estimated model explains the trip patterns for the sample of 443 anglers is to compare the mean of the actual number of trips with the mean of the number of trips predicted by the model. This comparison can be performed for the full sample or any subgroup of the sample. The estimated model should accurately predict the number of fishing trips for the sample as a whole, but the model's ability to predict the number of trips taken by a subgroup of the sample decreases the more narrowly defined the subgroup.[3]

The predicted number of trips for each angler in the sample was derived from the estimated model using the site sizes, expected catch rates, and the angler's trip costs, income, age, gender, skill, free time, residency, years fished in Montana, and weeks of paid vacation. For illustrative purposes, actual and predicted trips for selected subgroups are reported in Table 5-2. These results indicate the estimated model is accurately

[3] Fifty-three parameters cannot completely describe the number of trips taken by each of the 443 individuals in the sample, so the model may not exactly describe how many trips an individual will take or the average number of trips for a small subgroup such as nonresident females.

Table 5-2
Number of Fishing Trips: May through September 1992
Actual and Predicted

	Actual		Predicted	
	Mean	Median	Mean	Median
Full sample	13.05	7.00	12.88	11.91
Residents	17.87	13.00	17.62	17.82
Nonresidents	3.81	2.00	3.80	3.58
Missoula residents	22.29	14.50	19.71	19.81
Bozeman residents	16.40	13.00	17.35	17.73

predicting the actual number of trips — not just for the sample as a whole, but also for those in the sample who are residents of Montana, nonresidents, residents of Missoula, and residents of Bozeman.[4]

5.3.2 Actual and Estimated Site Choices

Another important gauge of how well the estimated model explains observed behavior is to compare the actual observed sample site proportions for the 26 intensively studied sites with the predicted site proportions. As with the number of trips, this comparison can be performed for the full sample or any subgroup of the sample, and the estimated model's ability to predict accurately site proportions for subgroups will decrease the more narrowly the subgroup is defined.

Predicted and actual site proportions for the 26 sites were calculated for the full sample, residents, nonresidents, residents of Missoula, and residents of Bozeman. The predicted and actual site proportions for the 26 sites for the full sample are in Table 5-3, and they are in Table 5-4 for residents and nonresidents.[5]

[4] The median number of trips in Table 5-2 is overpredicted because the model assumes a normal distribution while the actual data do not quite fit this pattern. This overprediction of the median occurs for both the current trips and predicted trips under baseline conditions, and therefore has minimal impact on the ultimate calculations of damages.

[5] Proportions of trips to each of the 26 intensively studied sites for the Missoula and Bozeman subgroups are presented in Table 5C-2 in Appendix 5C.

Table 5-3
Proportions of Trips to Each Site
Actual and Predicted
(proportion of trips to 26 sites)

River	Full Sample	
	Actual	Predicted
UCF 1	0.026	0.023
UCF 2	0.011	0.015
UCF 3	0.004	0.009
Middle CF	0.049	0.038
Rock Cr.	0.065	0.074
Flint Cr.	0.013	0.020
Bitterroot 1	0.038	0.028
Bitterroot 2	0.074	0.064
Lolo Cr.	0.012	0.010
Blackfoot	0.026	0.027
L. Blackfoot	0.017	0.029
UCF 4	0.007	0.013
UCF 5	0.015	0.018
Silver Bow Cr.	0.001	0.002
WSC	0.003	0.005
Big Hole 1	0.057	0.054
Big Hole 2	0.061	0.060
Jefferson 2	0.038	0.036
Beaverhead	0.049	0.040
Jefferson 1	0.017	0.019
Missouri	0.145	0.139
Yellowstone	0.038	0.030
Gallatin	0.040	0.041
E. Gallatin	0.024	0.023
Madison 1	0.058	0.058
Madison 2	0.113	0.124

Table 5-4
Proportions of Trips to Each Site for Residents and Nonresidents
Actual and Predicted
(proportion of trips to 26 sites)

River	Residents		Nonresidents	
	Actual	Predicted	Actual	Predicted
UCF 1	0.029	0.024	0.006	0.014
UCF 2	0.013	0.016	0.000	0.005
UCF 3	0.004	0.009	0.000	0.002
Middle CF	0.057	0.041	0.000	0.012
Rock Cr.	0.060	0.071	0.097	0.107
Flint Cr.	0.013	0.020	0.013	0.015
Bitterroot 1	0.044	0.030	0.000	0.013
Bitterroot 2	0.081	0.060	0.032	0.105
Lolo Cr.	0.014	0.011	0.000	0.007
Blackfoot	0.029	0.029	0.006	0.011
L. Blackfoot	0.019	0.031	0.000	0.010
UCF 4	0.007	0.014	0.006	0.002
UCF 5	0.017	0.018	0.000	0.008
Silver Bow Cr.	0.001	0.002	0.000	0.000
WSC	0.003	0.005	0.000	0.001
Big Hole 1	0.058	0.054	0.052	0.054
Big Hole 2	0.064	0.060	0.045	0.062
Jefferson 2	0.043	0.037	0.006	0.018
Beaverhead	0.039	0.033	0.116	0.111
Jefferson 1	0.019	0.021	0.000	0.006
Missouri	0.149	0.140	0.123	0.128
Yellowstone	0.039	0.030	0.032	0.030
Gallatin	0.040	0.043	0.045	0.016
E. Gallatin	0.026	0.024	0.006	0.008
Madison 1	0.064	0.060	0.019	0.035
Madison 2	0.069	0.116	0.394	0.221

The estimated model accurately predicts the site proportions for the sample as a whole. The correlation coefficients between the actual and predicted trip proportions are 0.98 for the full sample, 0.93 for residents, and 0.91 for nonresidents. The Spearman rank order correlations are 0.98 for the full sample, 0.96 for residents, and 0.88 for nonresidents. These correlation coefficients reflect a very high predictive power in the model.[6]

5.4 ESTIMATED EXPECTED CATCH RATES

The model's estimated expected catch rates for the 26 intensively studied sites are reported in Table 5-5 where they are ranked from highest to lowest. The top five sites include some of the most famous trout steams in the United States. In contrast, four of the eight sites with the lowest expected catch rates are impacted sites in the upper Clark Fork River Basin (Clark Fork 2, 3, and 4, and Silver Bow Creek). The site with the tenth highest expected catch rate is Clark Fork 5, an impacted stretch of the upper Clark Fork River that runs for two miles from Warm Springs Ponds to Perkins Lane. Upper Clark Fork 1, an impacted stretch that runs from where Rock Creek enters the Clark Fork to Milltown Dam just above Missoula, is ranked thirteenth. While the experienced angler might find these 26 estimated expected catch rates to be lower than he or she might have imagined, one must remember that a proportion of anglers have many days when they catch no fish. In our sample, for example, almost 50 percent of the 1,380 reported catch rates are zero.

In contrast to the current estimated expected catch rates, Chapter 6.0 provides estimates of what expected catch rates would be if there were no injuries to the upper Clark Fork River and Silver Bow Creek, i.e., the baseline expected catch rates. The extent of the injuries is not determined by whether a site currently has a high or low expected catch rate, but by the magnitudes of the injury-induced reductions in expected catch rates. A site that is currently good might have been even better.

There is a strong correlation between the estimated expected catch rates and the angler's rating of the sites in terms of perceived catch. On the mail survey, anglers rated seven sites on a scale from one to seven in terms of perceived catch.[7] A regression of the

[6] For a few sites, the observed and predicted site proportions deviate noticeably for residents and nonresidents. This is not unexpected when predicting 52 site proportions (26 sites × 2 residency categories). The sites with noticeable deviations have minimal impact on the computation of damages as they are neither the impacted sites nor principal substitute sites, and because the model will uniformly overpredict or underpredict for both the current and baseline injury conditions.

[7] Question 6 on Version 1 of the mail survey rates Big Hole 2, Rock Creek, combined Upper Clark Fork 2 and 3, and Missouri in terms of perceived catch. Version 2 rates Big Hole 2, Madison 2, Upper Clark Fork 4, and Jefferson 2 in terms of perceived catch (see Table 3-2).

Table 5-5
Estimated Expected Catch Rates
(trout per hour fishing)

River	Expected Catch Rate	River	Expected Catch Rate
Beaverhead	0.8599	Lolo Cr.	0.4367
Rock Cr.	0.7784	Missouri	0.3637
Bitterroot 2	0.7434	Gallatin	0.3574
Big Hole 2	0.7249	E. Gallatin	0.3491
Madison 2	0.6969	UCF 2	0.3350
Big Hole 1	0.6549	Bitterroot 1	0.3322
Flint Cr.	0.5360	Blackfoot	0.3166
Madison 1	0.5124	Jefferson 1	0.3161
Yellowstone	0.5111	UCF 4	0.2756
UCF 5	0.4972	UCF 3	0.1896
Jefferson 2	0.4765	Middle CF	0.1578
UCF 1	0.4521	WSC	0.1531
L. Blackfoot	0.4504	Silver Bow Cr.	0.0000

average rating of the perceived catch rate at each site on its estimated expected catch rate indicates the estimated expected catch rates explain 78 percent of the variation in the averages of the sites' perceived catch ratings. The regression equation is the following:

$$PCR_j = \propto + \gamma(ECR_j) + \upsilon_j$$

where:

PCR_j = average rating of anglers' perceptions of expected catch at site j; from mail survey (Q6) on a scale from one to seven (one = below average; seven = above average)

ECR_j = estimated expected catch rate (trout caught per hour) at site j from recreation demand model

υ_j = random error in observation j.

The regression statistics for the equation are provided in Table 5-6. The data used to estimate this angler ratings model as well as the predicted perceived catch ratings for each site are listed in Table 5-7. The strong correlation between the estimated expected catch rates and the anglers' rating of the sites in terms of perceived catch indicates the perceptions anglers hold about expected catch rates are consistent with our estimates of those expected catch rates. The relationship between expected catch rates and anglers' ratings of a site are illustrated in Figure 5-1.

There is also a strong correlation between the estimated catch rates and estimates of the fish stocks. The relationship between stocks and expected catch rates is demonstrated and discussed in Chapter 6.0. This correlation lends further support to the reliability of our estimates of the expected catch rates.

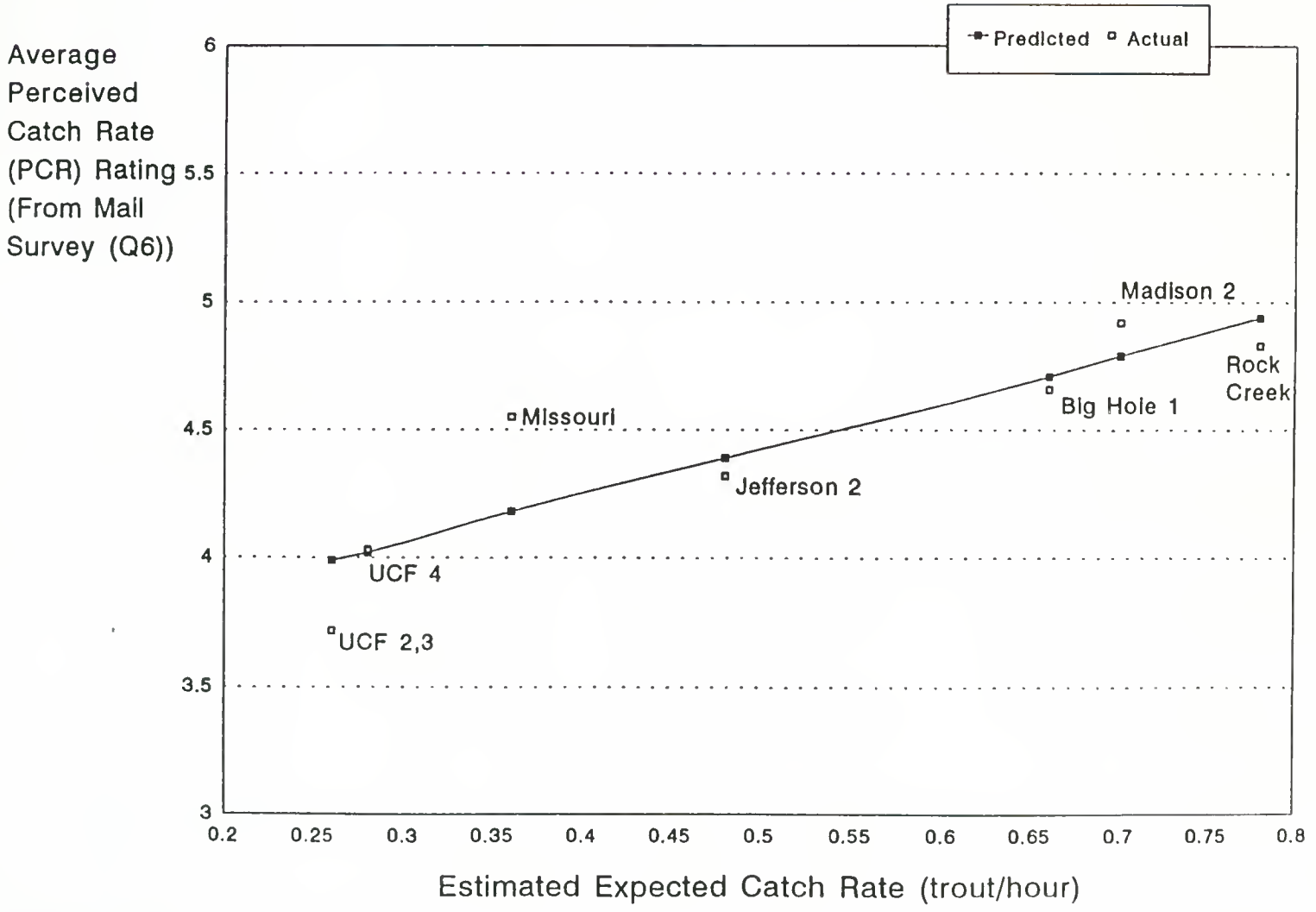
Table 5-6
Regression Statistics of the Angler Ratings Model

NOBS	R^2	Adj. R^2	F	$\hat{\alpha}$ (t-stat)	$\hat{\gamma}$ (t-stat)
7	0.78	0.74	18.10	3.51 (15.14)	1.84 (4.25)

Table 5-7
Perceived Catch Rate Ratings (Q6 on the mail survey) and Estimated Expected Catch Rates

River	Estimated Catch Rate (recreation demand model)	Perceived Catch Rating (mail survey Q6)	Predicted Perceived Catch Rating (from angler ratings model)
UCF 2 and UCF 3	0.26	3.72	3.99
UCF 4	0.28	4.03	4.02
Rock Cr.	0.78	4.83	4.94
Big Hole 2	0.66	4.66	4.71
Jefferson 2	0.48	4.32	4.39
Missouri	0.36	4.55	4.18
Madison 2	0.70	4.92	4.79

Figure 5-1
Perceived vs. Estimated Catch Rates



6.0 THE RELATIONSHIP BETWEEN TROUT STOCKS AND EXPECTED CATCH RATES: THE STOCK/HARVEST MODEL

A "stock/harvest" model was developed to investigate the relationship between trout stocks and expected catch rates. This model was estimated using current stock estimates and our current expected catch rate estimates. The stock/harvest model and our estimates of baseline (no-injury) stocks were then used to predict baseline expected catch rates at the injured sites under baseline conditions. Frequently in the literature, expected catch rates are estimated based on the assumption that if stocks would double in the absence of injuries, then expected catch rates would also double (assuming a 1:1 ratio). Compared to this assumption, our stock/harvest model yields more conservative estimates of the increases in expected catch rates at the impacted sites for the baseline scenario.

6.1 THE STOCK/HARVEST MODEL

Trout stock estimates, which are measured in number of trout per hectare (10,000 square meters), were calculated using 1992 trout stock data collected for nine of our sites (Don Chapman Consultants, 1993). The data were collected by snorkeling and include brook, brown, and rainbow trout. The nine sites that were sampled were the five upper Clark Fork River sites, Silver Bow Creek, Rock Creek, Beaverhead, and Big Hole 1. For each site, stock data were collected for at least one stretch of river within the site. In the cases for which data were collected for more than one stretch of river, stock estimates were calculated using an average of the stocks at each stretch weighted by the length of the stretch in river miles (see Appendix 6A). The 1992 stock estimates for the nine sites are reported in Table 6-1.

Our stock estimates range from zero fish per hectare at Silver Bow Creek to 773.7 at Beaverhead. Note the variation among stocks at Clark Fork sites. The stock at Upper Clark Fork 5 is over 80 times larger than the stock at Upper Clark Fork 2.

Table 6-1
1992 Stock Estimates in Trout per Hectare

River	Stock	River	Stock	River	Stock
UCF 1	63.82	UCF 4	136.27	Rock Cr.	206.34
UCF 2	7.14	UCF 5	583.70	Beaverhead	773.70
UCF 3	13.78	Silver Bow Cr.	0.00	Big Hole 1	38.02

There exists a strong relationship between estimated expected catch rates and stocks. The following regression equation was used to relate the estimated catch rates to estimated stocks:

$$ECR_j = \phi \ln (STOCK_j + 1) + \omega_j$$

where:

ECR_j = expected catch rate (trout caught per hour) at site j from the recreation demand model

$STOCK_j$ = 1992 stock estimate (number of trout per hectare) at site j from Don Chapman Consultants (1993)

ω_j = random error in observation j.

The functional form of the regression allows for a nonlinear stock-harvest relationship (which provided a better statistical fit to the data than did a linear model), and the regression predicts zero expected catch where stocks are zero. The data used to estimate the model are in Table 6-2. The regression results are provided in Table 6-3. This model explains 90 percent of the variation in estimated expected catch rates and is highly statistically significant. Figure 6-1 illustrates the relationship between estimated expected catch rates and stocks for the nine sites used in the analysis.

Overall, the model demonstrates a broad consistency between the estimated stocks and estimated expected catch rates. Therefore, this model provides a strong basis for computing expected catch rates under baseline conditions at the impacted sites.

6.2 EXPECTED STOCKS IN THE CLARK FORK RIVER BASIN IN THE ABSENCE OF INJURIES

In the previous section, we estimated stocks for current conditions at the upper Clark Fork River sites and Silver Bow Creek. Now we estimate stocks for these sites if there were no injuries, i.e., the baseline stocks.

In the injury quantification reports, stock data for Rock Creek, Beaverhead, Flint Creek, the Ruby River, Bison Creek, and Big Hole 1 were used to estimate stocks at the upper Clark Fork River sites and Silver Bow Creek for the baseline (no-injury) conditions (Don Chapman Consultants, 1993).[1] These sites were selected as reference sites for the

[1] Stock estimates for the baseline (no-injury) conditions were calculated using the same weighting procedure as for current stock estimates. Flint Creek was not used in the stock/harvest model because the Flint Creek stretch for which stocks were measured does not overlap at all with our Flint Creek site. Neither the Ruby River nor Bison Creek is one of the 26 intensively studied sites, and these two sites were also not used in the stock/harvest model.

Table 6-2
Stock/Harvest Model Data and Predicted Values of
Expected Catch Rates (per hour)

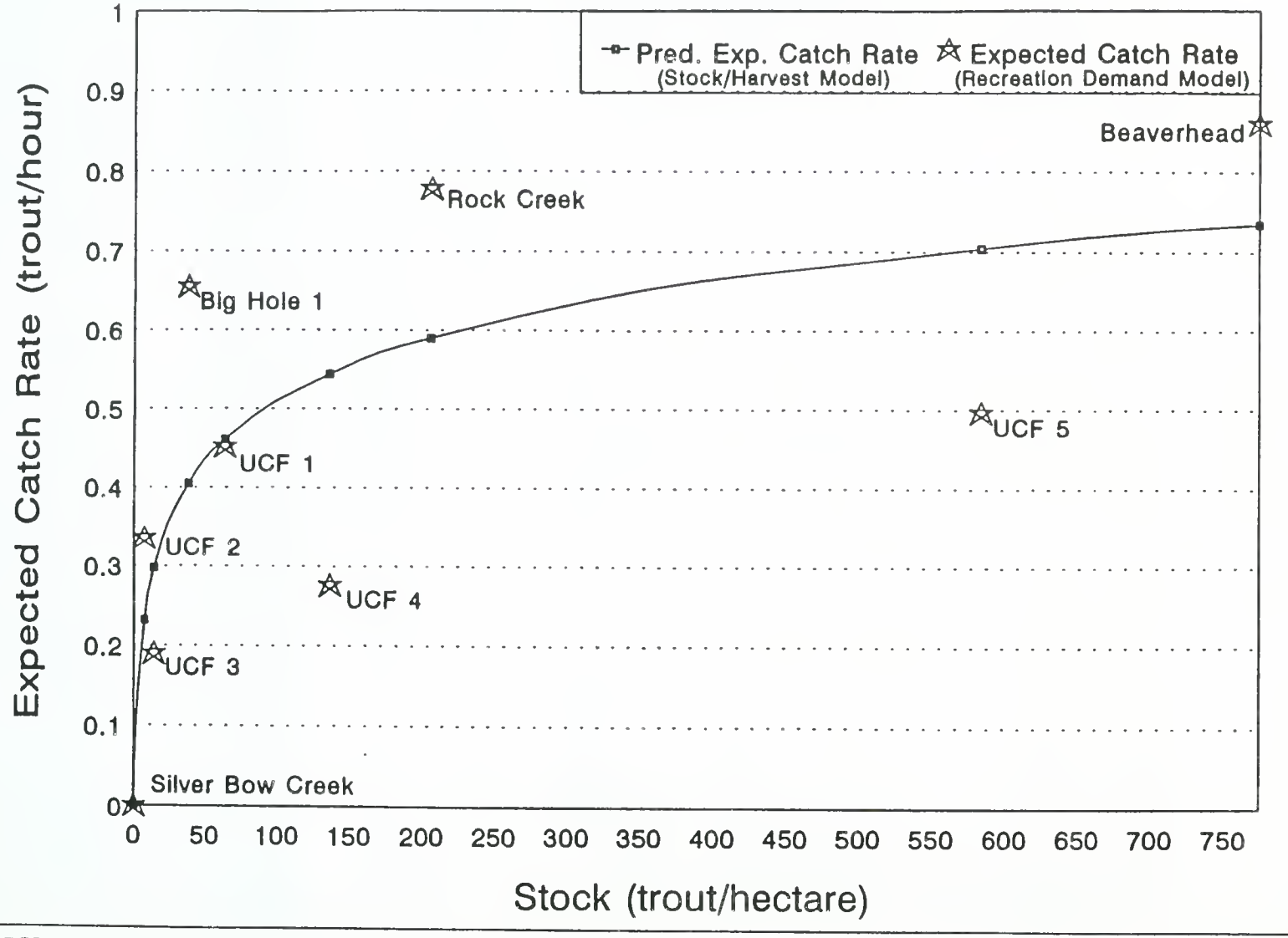
River	Stock	Recreation Demand Model Estimates of Expected Catch Rates	Stock/Harvest Model Predictions of Expected Catch Rates
UCF 1	63.82	0.452	0.461
UCF 2	7.14	0.335	0.232
UCF 3	13.78	0.190	0.298
UCF 4	136.27	0.276	0.544
UCF 5	583.70	0.497	0.704
Silver Bow Cr.	0.00	0.000*	0.000
Rock Creek	206.34	0.778	0.590
Beaverhead	773.70	0.860	0.735
Big Hole 1	38.02	0.655	0.405

* See Table 5-5.

Table 6-3
Regression Statistics from Stock/Harvest Model

NOBS	R^2	Adj. R^2	F	$\hat{\phi}$ (t-stat)
9	0.90	0.88	70.103	0.11053 (8.373)

Figure 6-1
Expected Catch vs. Stock



injured sites because they have ecological and geological characteristics, or *state types*, similar to segments in the upper Clark Fork River and Silver Bow Creek (Don Chapman Consultants, 1993). Adjustments were made for the effects of habitat and flow differences between the injured and reference sites. Table 6-4 compares stock estimates for the current (injury) and the baseline (no-injury) conditions.

The largest differences between the current and baseline stock estimates are for Silver Bow Creek and Upper Clark Fork 2. The baseline stock estimate at Upper Clark Fork 2 is over 19 times larger than the current stock estimate. Note that the stock in Upper Clark Fork 5 is predicted to be somewhat larger in its current state than it would be in the baseline conditions due to various man-made factors. Weighted by river miles (from Don Chapman Consultants, 1993), the average current stock for all sites in Table 6-4 is 51.74 trout per hectare. Under baseline conditions, the weighted average stock increases by a factor of 3.73 to 192.96 trout per hectare.

6.3 USING THE STOCK/HARVEST MODEL TO CALCULATE EXPECTED CATCH RATES IN THE ABSENCE OF INJURIES

The stock/harvest model was used to estimate expected catch rates under the baseline (no-injury) conditions. Specifically, the baseline expected catch rate for each site was calculated by multiplying the current expected catch rate by the ratio of the predicted baseline catch rate to the predicted current expected catch rate from the stock/harvest model. Table 6-5 and Figure 6-2 compare expected catch rates for the current and baseline cases.

The data in Table 6-5 can be used to compute the average change in catch rates across the impacted sites, weighted by the length of each site. Across all 145.1 river miles covered by the injured sites, the average change in expected catch per four hours of fishing, which is just less than the length of the average visit for residents, is about one (1.054) fish. This amounts to more than doubling (109 percent increase) the average expected catch rates over the 145 miles.

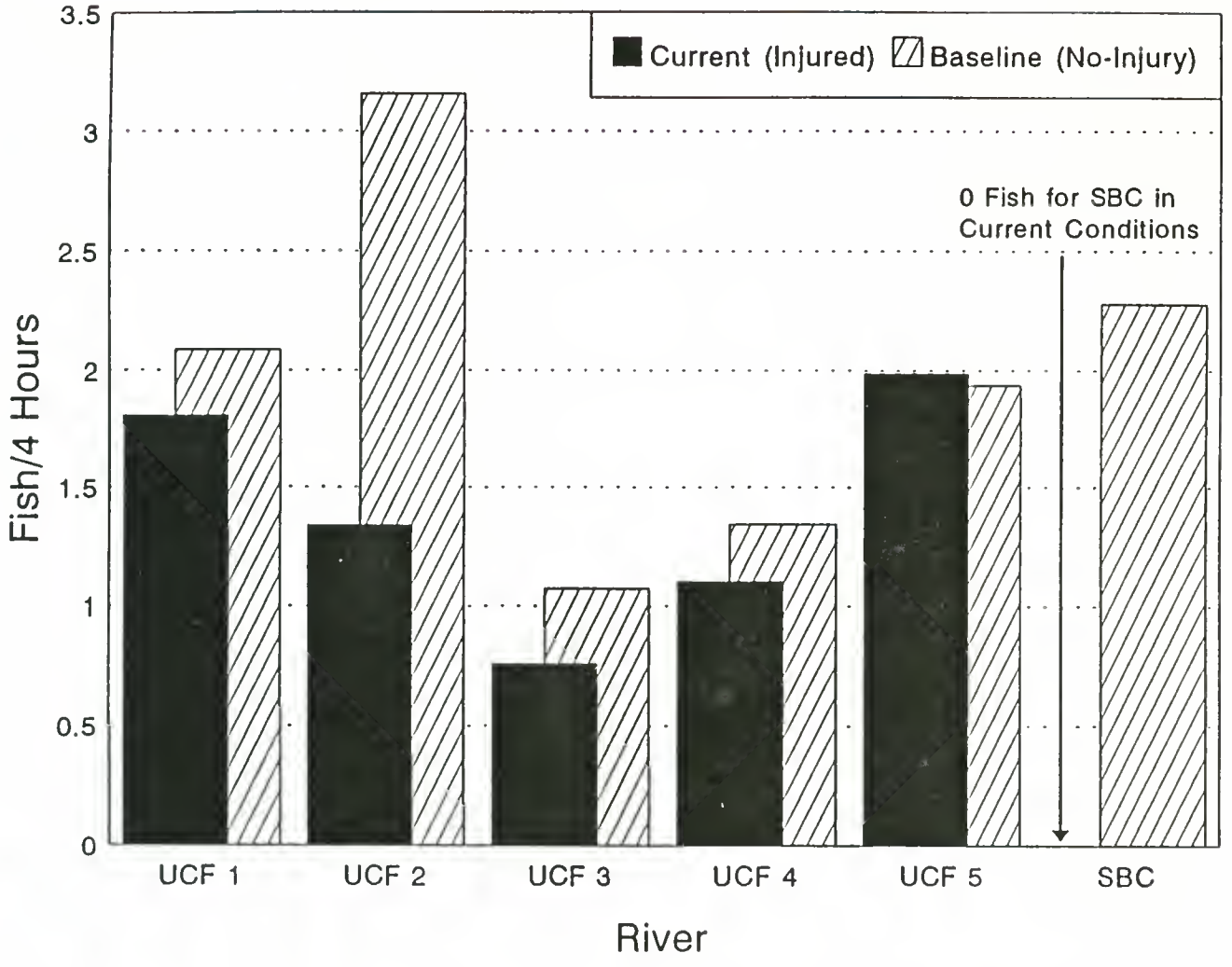
Table 6-4
Stock Estimates for Current and Baseline Conditions
(trout/hectare)

River	Length in River Miles	Current (injured)	Baseline (no-injury)
UCF 1	16.7	63.82	123.05
UCF 2	35.1	7.14	139.49
UCF 3	27.4	13.78	43.58
UCF 4	34.1	136.27	402.66
UCF 5	2.0	583.70	493.70
Silver Bow Cr.	29.8	0.00	172.33

Table 6-5
Best Estimates of Expected Catch Rates for Current and Baseline Conditions

River	Length in Miles	Expected Catch Rates				Change per 4 Hours
		Current (injured)		Baseline (no-injury)		
		1 Hour	4 Hours	1 Hour	4 Hours	
UCF 1	16.7	0.452	1.808	0.522	2.088	0.280
UCF 2	35.1	0.335	1.340	0.789	3.156	1.816
UCF 3	27.4	0.190	0.760	0.268	1.072	0.312
UCF 4	34.1	0.276	1.104	0.336	1.344	0.240
UCF 5	2.0	0.497	1.988	0.484	1.936	-0.052
Silver Bow Cr.	29.8	0.000	0.000	0.570	2.280	2.28

Figure 6-2
Expected Catch Rates per Four Hours of Fishing



7.0 DEMAND FOR FISHING TRIPS AND BENEFITS UNDER BASELINE CONDITIONS AT THE CLARK FORK RIVER AND SILVER BOW CREEK

7.1 INTRODUCTION

Both the recreation demand model and the contingent behavior questions in the follow-up mail survey are used in this chapter to estimate how changes in expected catch at the upper Clark Fork River and Silver Bow Creek will affect site visitation by individual anglers. The estimates from the two sources are quite similar. The recreation demand model is also used to estimate the value that existing anglers place on returning the impacted sites to baseline conditions. These use and value estimates omit the potential for an increase in the population of anglers due to the improved catch rates at the impacted sites, which results in a downward bias in the damage estimates. Finally, the sample use and value estimates are extrapolated to the relevant Montana angling population to derive total use estimates and total damages for summer 1992. Estimates of total damages for other years are presented in Chapter 9.0.

7.2 INCREASED FISHING ACTIVITY UNDER BASELINE CONDITIONS

7.2.1 Recreation Demand Model

The recreation demand model is combined with the estimated expected catch rates under baseline conditions (Chapter 6.0) to determine how many more fishing trips anglers would take under baseline conditions during May through September, and how those trips would be allocated across the rivers and streams in Southwestern Montana.

The recreation demand model predicts that if baseline conditions were restored at the impacted upper Clark Fork River and Silver Bow Creek sites, an average resident angler in the study sample would take 1.2351 more trips per season to the impacted sites and 1.1956 fewer trips to other sites in Montana for a net increase of 0.0395 trips per season. The predicted trips to the impacted sites under baseline conditions represent a 118 percent increase relative to the predicted trips under current conditions. The average nonresident angler in the study would take 0.2114 more trips to the impacted sites and 0.2025 fewer trips to other sites for a net increase of 0.0089 trips per season. The net change is a 313 percent increase in the total number of trips to the impacted sites for nonresidents. In summary, few new trips are predicted to be taken by existing anglers, but just under 10 percent of trips to other sites are predicted to be substituted to the impacted sites when the impacted sites are returned to baseline conditions.

The increase in visitation to the impacted sites under baseline conditions varies across sites. This variability reflects the variability in increased expected catch rates, as reported

in Table 6-5. For example, under baseline conditions the expected catch rate at Upper Clark Fork 2 would increase by 135 percent, and the site would be comparable to sites such as Rock Creek, Beaverhead, and Big Hole 1. The Upper Clark Fork 5 expected catch rate would experience little change, and visitation would decrease as trips are substituted to other sites. Table 7-1 reports the predicted site proportions with and without injuries for the 26 intensively studied sites. As compared to current conditions, the predicted visitation increases dramatically (467 percent) at Upper Clark Fork 2 under baseline conditions. Visitation at Upper Clark Fork 2 is predicted to equal or exceed visitation at Rock Creek, the Bitterroot River, and other popular sites. This reflects the relatively high expected catch rate at the impacted site under baseline conditions, the size of the site, and that this site is closer than other substitute sites for residents of nearby cities such as Missoula, Helena, and Butte (and therefore, there are lower costs associated with visiting the site).

Table 7-1
Proportions of Trips to Each Site for All Anglers
Predicted with Injuries and with No Injuries
(proportion of trips to 26 sites)

River	Injuries	No Injuries	River	Injuries	No Injuries
UCF 1	0.0229	0.0255	Silver Bow Cr.	0.0023	0.0239
UCF 2	0.0153	0.0854	WSC	0.0046	0.0041
UCF 3	0.0085	0.0088	Big Hole 1	0.0540	0.0490
Middle CF	0.0385	0.0320	Big Hole 2	0.0602	0.0540
Rock Cr.	0.0744	0.0591	Jefferson 2	0.0355	0.0321
Flint Cr.	0.0198	0.0151	Beaverhead	0.0400	0.0365
Bitterroot 1	0.0284	0.0244	Jefferson 1	0.0194	0.0175
Bitterroot 2	0.0639	0.0542	Missouri	0.1391	0.1332
Lolo Cr.	0.0104	0.0087	Yellowstone	0.0300	0.0288
Blackfoot	0.0272	0.0216	Gallatin	0.0411	0.0394
L. Blackfoot	0.0298	0.0212	E. Gallatin	0.0227	0.0217
UCF 4	0.0126	0.0142	Madison 1	0.0583	0.0558
UCF 5	0.0176	0.0147	Madison 2	0.1244	0.1192

Remediating injuries would also have a dramatic impact on Silver Bow Creek, making it an excellent small stream for trout fishing. The model predicts the share of trips to Silver Bow Creek would substantially increase if the site were returned to baseline conditions, and there would be more trips to Silver Bow Creek than to Flint Creek, Clark Fork 4, Clark Fork 5, Jefferson 1, or East Gallatin. Without injuries the Clark Fork River and Silver Bow Creek would provide one of the premiere fishing areas in Southwestern Montana.

The model predicts that under baseline conditions anglers will substitute fishing visits from other sites to the upper Clark Fork River and Silver Bow Creek sites. This implies that anglers are currently taking trips to sites that, under baseline conditions, would be less desirable due to lower catch rates or increased travel distances. The model predicts that many of the trips to the upper Clark Fork and Silver Bow Creek sites under baseline conditions will come from Rock Creek, Flint Creek, Bitterroot 2, Little Blackfoot, and the Big Hole River. These sites are at considerable distance from Upper Clark Fork 2 and Silver Bow Creek.

The recreation demand model predicts that the change in visitation to the impacted sites under baseline conditions would be the greatest for residents who live in the Clark Fork River Basin. For example, Missoula anglers would take 1.518 more trips to the impacted sites and 1.474 fewer trips to other sites for a net increase in 0.0436 trips per season. While the increase in visits to the impacted sites is larger for local residents as compared to other anglers, the percentage change is smaller due to the larger number of total trips taken to Clark Fork Basin sites by local residents.

7.2.2 The Contingent Behavior Model and Comparison to the Recreation Demand Model

Questions 12 through 21 of the follow-up mail survey asked anglers to predict how their fishing behavior would have changed with changes in expected catch rates at selected sites. This analysis is discussed in Section 3.1. These results can be compared to the recreation demand model to verify whether the recreation demand model reasonably predicts what anglers indicated their expected change in behavior would have been. For the comparison, the site used is combined Clark Fork 2 and 3. The hypothetical change considered for the contingent behavior analysis is one fish per four hours of fishing. This scenario is the most similar to the change in expected catch rates under baseline conditions at Clark Fork 2 and 3. The comparison is presented in Table 7-2 and is discussed below.

In the contingent behavior model (CBM) questions, respondents indicated their expected response to changes in fish catch that would occur at only one site. The contingent behavior results from Table 3-2 are again listed in Table 7-2 for Clark Fork 2 and 3 for the scenario of an increase in expected catch of one fish in four hours of fishing.

Table 7-2
Comparison of Recreation Demand Model and Contingent Behavior Model Predictions of Changes in Trips*

Variable		Contingent Behavior Model	Recreation Demand Model	
	Site	Clark Fork 2 and 3	All Impacted Sites	Clark Fork 2 and 3
A.	Change in trips predicted (SE of mean)	1.07 (0.253)	0.885	0.668 = 0.885 × 0.755
B.	Change in expected trout catch per 4 hours of fishing	1	1.05	1.16
C.	(Change in trips) / (Change in catch per 4 hours of fishing)	1.07	0.84	0.58
D.	Change in visits to other sites	-0.27	-0.86	N/A

* Contingent behavior results from the mail survey are annual and for changes at one site at a time. Recreation demand model results from trip data are for simultaneous changes at all Clark Fork sites and Silver Bow Creek. Recreation demand model visitation results for Clark Fork 2 and 3 are the share of increased visits to all impacted sites for the summer season.

The results from the recreation demand model (RDM) for the change in catch for all impacted sites are listed in the third column in Table 7-2. The change in trips to the impacted sites is the weighted average of the residents (66 percent of the sample taking 1.235 more trips to the sites) and nonresidents (34 percent of the sample taking 0.2114 more trips to the sites) and equals 0.885. The change in expected catch per four hours of fishing averaged across all sites, weighted by river miles (Table 6-5), is 1.054.

The CBM results are for changes in expected catch rates at one site at a time, while the RDM results are for the predicted changes in expected catch rates at all impacted sites. To compare the CBM and RDM results, the share of increased trips to Clark Fork sites 2 and 3 in the RDM is computed as 0.668 (column 4 in Table 7-2), or 75.5 percent of the increase in trips to all of the impacted sites when they are simultaneously returned to baseline conditions (based on the proportions in Table 7-1). The increased catch per

four hours of fishing of 1.16 is the miles-weighted increase in predicted catch for Clark Fork 2 and 3 only (Table 6-5).

The CBM and RDM results show a high degree of correspondence between respondents' predicted behavior in the CBM and observed behavior modeled in the RDM. For Clark Fork 2 and 3, the CBM predicts an increase of 1.07 visits per year to Clark Fork 2 and 3 if trout catch increases at these sites alone by one fish in four hours. The RDM predicts an increase in visits to Clark Fork 2 and 3 of 0.58 visits per season if this site *and* several other sites are all improved simultaneously. These estimates are very close given the relatively small sample sizes in the CBM comparison scenario. Further, if only Clark Fork 2 and 3 were enhanced, and the other sites were to remain in the injured conditions (as is assumed in the CBM approach), the RDM estimate for Clark Fork 2 and 3 would increase and more nearly equal the CBM estimate. This is because trips that are taken to other improved sites (such as Silver Bow Creek) under baseline conditions would instead be taken to Clark Fork 2 and 3 *and* there would be more substitution to Clark Fork 2 and 3 from other Clark Fork sites if the other sites were not simultaneously returned to baseline conditions. Additionally, the CBM estimate is an annual figure whereas the RDM estimate applies only to the summer season (May through September). Adjusting the RDM result upward to account for the entire year would increase the RDM estimates by about one-third and would also make the estimates more similar. See Sections 7.4.3 and 9.1.4 for further discussion of the relationship between summer season and annual statistics.

The CBM and RDM estimates are also consistent in predicting that Clark Fork Basin residents would be more responsive to improvements in conditions at the impacted sites. The CBM results indicate that the increase in trips to the impacted sites would be about 50 percent larger for individuals who had previously visited Clark Fork 2 and 3 (generally Clark Fork Basin residents) as compared to the sample as a whole. Similarly, the RDM predicts that the increase in trips to the impacted sites would be about 23 percent larger for Clark Fork Basin residents in the sample as compared to the sample as a whole.

The CBM and RDM results differ in terms of predictions of changes in visits to other sites as the impacted sites are returned to baseline conditions. Respondents in the CBM analysis predict that most of the increase in trips to the impacted sites will be new trips, while the RDM predicts that most of the trips will be substituted from other sites. In this regard the RDM is predicting a more conservative change in behavior than respondents directly indicate they would undertake.

As previously noted, the contingent behavior method, combined with existing recreational fishing valuation literature, can be used to provide an alternative use value damage estimate consistent with the DOI NRDA regulations [43 CFR § 11.83 (d)(5)(i), 43 CFR § 11.83 (d)(6), and Proposed 43 CFR § 11.83 (c)(2)(ii)(E)].

Based on the contingent behavior results reported here, these alternative estimates would be approximately equal to, or somewhat larger than, the recreation demand model results if the recreation demand model WTP estimates were applied. If other literature WTP/trip values were applied (see pages 1-7 and 7-13), the contingent behavior valuation would exceed the recreation demand model valuation.

7.3 PER ANGLER ESTIMATED SEASONAL WTP FOR BASELINE CONDITIONS

This section reports estimates of seasonal (May-September) willingness to pay in 1992 of individual anglers to obtain baseline expected catch rates at the Clark Fork River and Silver Bow Creek. These estimates are then evaluated and compared to prior estimates in the literature.

7.3.1 Individual Damage Estimates

The recreation demand model is used to estimate summer WTP for the baseline (no-injury) expected catch rates for each of the 443 anglers in our sample as a function of the angler's trip costs, income, age, gender, available free time, and other characteristics. See Appendix 7A for derivation of WTP. For anglers in the sample who are residents of Montana, estimated seasonal WTP ranges from $11.95 to $275.69 with a mean of $75.28 and a median of $72.49. For anglers in the sample who are not residents of Montana, estimated WTP ranges from $0.29 to $50.52 with a mean of $13.25 and a median of $11.52. These estimates are reported in Table 7-3. The distribution of WTP for residents is plotted in Figure 7-1, and the distribution of WTP for nonresidents is plotted in Figure 7-2. WTP of residents is generally much higher because trip costs of residents to the injured sites are much lower.

The distribution of WTP for residents shows that there is a very small proportion of resident anglers with an estimated WTP that is significantly higher than the WTP of most resident anglers. That the estimated mean WTP of residents is only four percent higher than the median indicates that these outliers are not pulling up the mean to any significant degree. The distribution of WTP for nonresidents results in a mean estimate that is about 15 percent larger than the median value estimate. The distribution of values for the combined sample of residents and nonresidents has a larger difference between the mean and median values because of the substantial difference between the resident and nonresident value distributions (Figures 7-1 and 7-2).

WTP varies across the anglers in our sample because trip costs, income, and the other determinants of WTP vary across the anglers in our sample. Consider the angler in the sample with the highest estimated WTP ($275.69), and compare this angler with an angler with a WTP that is effectively zero ($0.29). The angler with a WTP of $275.69

Table 7-3
Seasonal* WTP for the Baseline Expected Catch Rates at the Clark Fork River and Silver Bow Creek

WTP	All Anglers	Nonresidents	Residents	Bozeman Residents	Missoula Residents
Mean	$54.00	$13.25	$75.28	$88.84	$85.77
Median	$44.92	$11.52	$72.49	$94.83	$86.30
Minimum	$ 0.29	$ 0.29	$11.95	$11.95	$24.40
Maximum	$275.69	$50.52	$275.69	$275.69	$165.39

* May-September 1992 for study sample.

Figure 7-1
Summer Season WTP for Residents

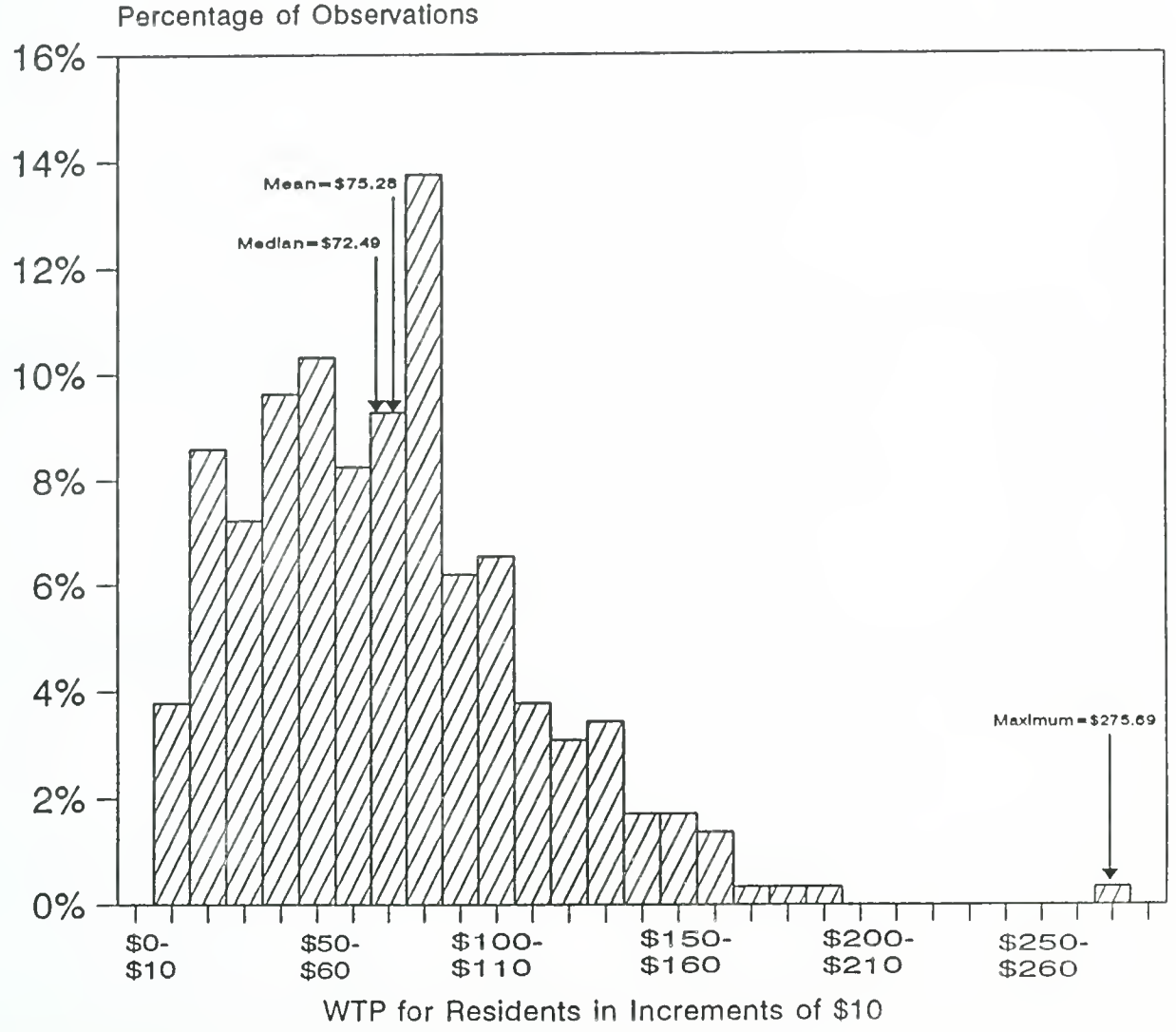
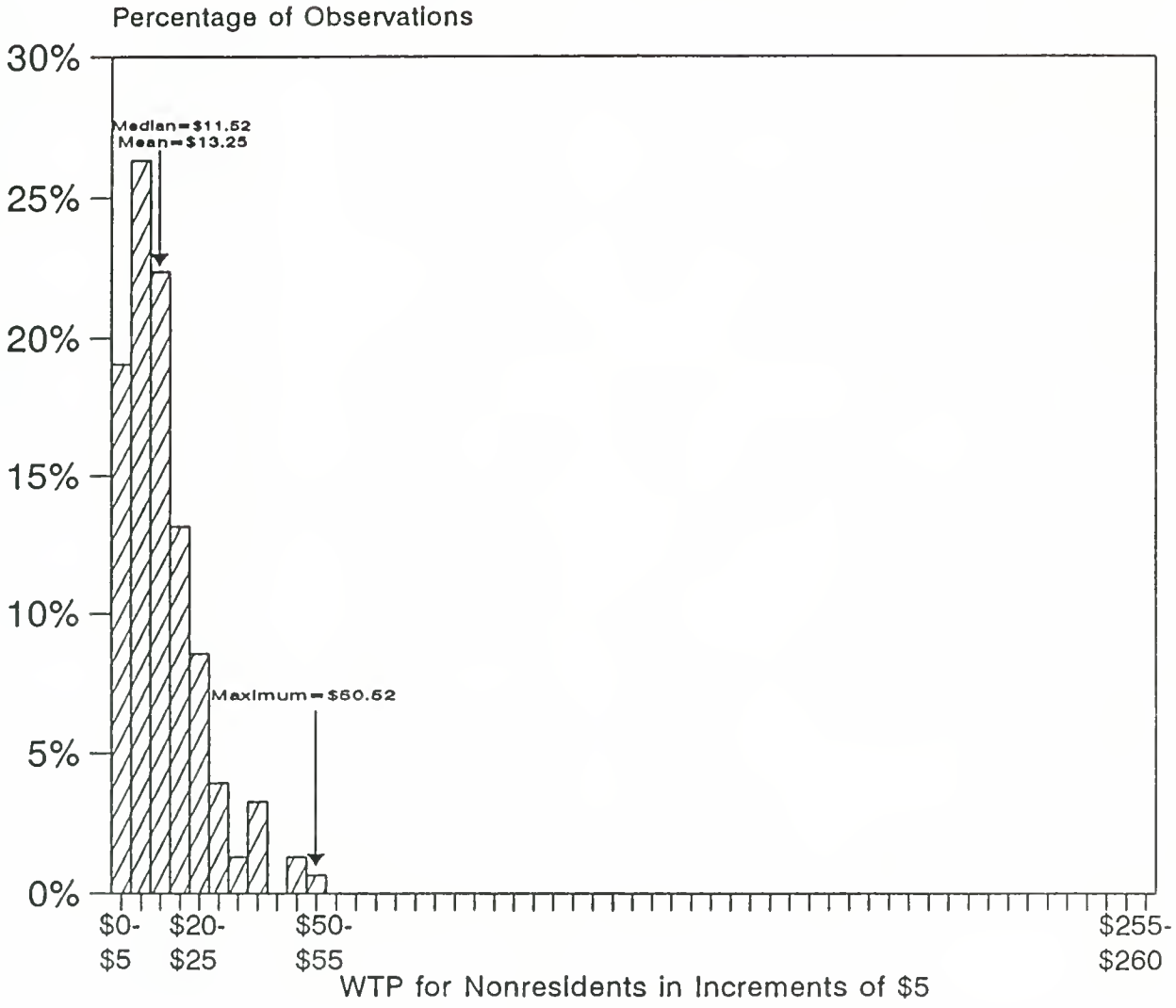


Figure 7-2
Summer Season WTP for Nonresidents



resides near the Clark Fork River, is a 49-year-old male, reports a skill level of 7 on a scale of 1 to 7, reports 11 hours of free time in a typical weekday, and reports a household income of $90,000 and a wage rate of $50 per hour. This is a very avid angler with low trip costs for the injured sites, a higher than average amount of free time, and greater ability to pay as measured in terms of income. In contrast, the angler with a WTP of effectively zero is a 32-year-old female from California, with a reported skill level of 1, four hours of free time on a typical weekday, a wage rate of $50, and a household income of $112,000.

The importance of trip costs and income with respect to the estimated WTP can be seen by comparing the average WTP of all Montana residents with the average WTP of those who reside close to the injured sites. Mean and median WTP are listed in Table 7-3 for all Montana residents, for residents of Missoula, and for residents of Bozeman. Comparing the columns of Table 7-3 one sees the influence of both distance and income on WTP. Residents of Missoula and Bozeman live closer to the impacted sites than does the average resident angler. Everything else constant, this implies residents of Missoula and Bozeman face lower trip costs for the impacted sites. As a result, the WTP to achieve baseline conditions is higher for residents of Missoula and Bozeman than for residents in general. However, this is not the only influence at work. If the differences in the last three columns of Table 7-3 were due solely to distance, Missoula residents would have a higher average WTP than Bozeman residents, but this is not the case. While Bozeman residents are further from most of the impacted sites, this increase in distance for Bozeman residents is offset by a combination of their greater avidity for fishing and their higher average income. Average income for the anglers in our sample from Bozeman is $39,029; the average for Missoula is $35,327.[1]

The influence of income on WTP is more clearly seen by choosing an angler from the sample who is a typical resident angler in terms of gender, age, skill, trip costs, etc., and using the model to estimate his WTP for each of a sequence of income levels starting with $5,000 per year and increasing to $200,000 per year, the income range in the sample.[2] WTP for this representative resident angler as a function of income level is plotted in Figure 7-3. Estimated seasonal WTP increases from $39 to $91 at a decreasing rate.

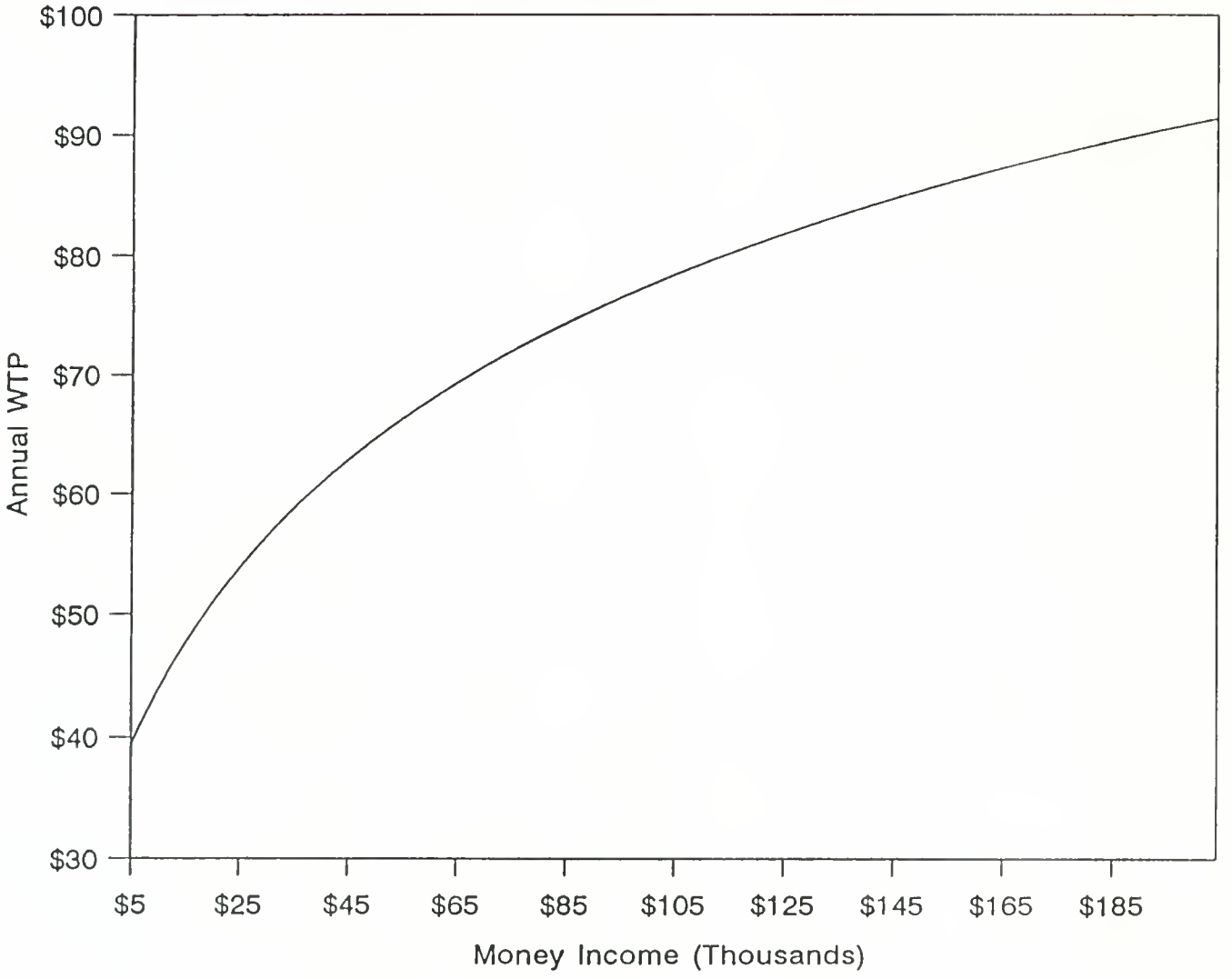
In terms of the other determinants of estimated WTP, everything else constant, estimated WTP is an increasing function of fishing skill and hours of free time on a typical weekday. It is a decreasing function of age, years fished in Montana, and weeks of paid vacation. Everything else constant, estimated WTP is greater for males and greater for residents.

---

[1] The average wage for the sample is also higher in Bozeman ($15.71 versus Missoula's $12.86).

[2] The characteristics of this angler are: a male resident 57 years of age, with a wage rate of $10 per hour, an income of $25,000, six years of experience fishing in Montana, and ten hours of free time available.

Figure 7-3
The Effect of Income on a Representative Resident Angler's Summer Season WTP



7.3.2 Standard Errors of the Mean Damage Estimates

Standard deviations for the estimated mean damages per angler were estimated through repeated simulations of the recreation demand model. Our estimated parameters and estimated variance-covariance matrix imply a distribution function for our 53 parameters. We randomly drew 300 parameter vectors from this distribution. For each of these parameter vectors we derived the WTP for each angler in our sample. This process generated an estimated distribution function for the mean WTP from which we estimated the standard deviation of the mean. The estimated standard deviation of the mean is $17.77 for residents, $5.55 for nonresidents, and $13.43 for the combined sample.

7.3.3 Comparison of the Individual Angler Damage Estimates to Other Estimates

Our damage estimates are comparable to other damage estimates. The recreation demand model damage estimates can be converted to a dollar per expected trip basis. These values can be shown to be comparable to values in the literature and comparable to the travel costs to visit substitute sites, many of which have similar or lower expected catch rates than the impacted sites under baseline conditions.

If one assumes that all WTP from the recreation demand model is just for the new trips to the impacted sites, the dollar per expected additional trip to the impacted sites for residents is $60.95 ($75.28 mean WTP per season/1.235 mean additional trips per season). For nonresidents the dollar per expected additional trip to the impacted sites is $62.69 ($13.25 WTP/0.2114 additional trips).

An approximate value of $61 per trip for improvements in the impacted Clark Fork sites is comparable to the added vehicle and travel-time costs of substituting a fishing trip from another site located about 60 miles away (one-way) from the impacted sites.[3] As identified in Table 7-1, additional trips to the impacted sites under baseline conditions generally result from substituting trips from other Southwestern Montana sites such as Rock Creek, the Little Blackfoot River, Flint Creek, the Bitterroot River, and the Big Hole River. For illustration, the approximate one-way distances between the center of Clark Fork 2 or the center of Silver Bow Creek (the impacted sites with the largest predicted changes in use) and primary substitute sites using major roads and highways are listed in Table 7-4. These distances average 50 to 60 miles. In summary, under current conditions anglers are visiting other sites than the impacted sites, some with lower expected catch rates than Upper Clark Fork 2 and Silver Bow Creek at baseline conditions, and some at considerable distances from the impacted sites, which causes higher vehicle and travel-time damages to the anglers.

[3] Assuming $15/hour average wage, the value of travel time (0.6 × hourly wage), vehicle costs of $0.28/mile, and 45 MPH average travel speed result in $0.48/mile costs. Therefore, added travel of 100 miles round trip increases travel costs by about $48.

Table 7-4
One-Way Distances in Miles Between Selected Impacted and Substitute Sites

Substitute Site	Distance from Upper Clark Fork 2 Site	Distance from Silver Bow Creek Site
Rock Creek	24	70
Little Blackfoot	44	46
Bitterroot 2	78	93
Big Hole 1	108	46
Big Hole 2	90	24
Flint Creek	33	49

Several previous studies have estimated per-trip recreational fishing benefits for sites in Southwestern Montana and provide another source for comparison. For example, Duffield (1991) reported estimates of average net benefits per trip of $135/trip for Rock Creek, $79/trip for the Blackfoot, and $55/trip for the Bitterroot. In Duffield's study, the difference in value per trip for the current upper Clark Fork sites and for Rock Creek, which is similar to the impacted sites under baseline conditions, is about $90.00, which is even greater than the average values estimated by the recreation demand model reported here. Duffield *et al.* (1988) report estimates varying from $58/trip for the Bitterroot to $228/trip for the Madison.

Duffield (1989) also estimated the WTP per trip to avoid a fifty-percent decrease in the Rock Creek expected catch rate, a scenario similar to the improvement expected at the impacted sites if they are returned to baseline conditions, to be $80 to $100. This value is also greater than the estimates reported using our recreation demand model.

7.4 ESTIMATED TOTAL RECREATIONAL FISHING DAMAGES FOR SUMMER 1992

To estimate total recreational fishing damages for summer 1992, we must take the average damages for the study sample from the recreation demand model and extrapolate to all relevant Montana anglers, including residents and nonresidents. We also adjust damages for the relative avidity of the anglers in our sample as compared to the population of Montana anglers. To compute damages for 1992, we first calculate the

total number of resident and nonresident anglers who fish at all sites in Montana. Second, we calculate the proportion of all Montana anglers who are active in river or stream fishing in Southwestern Montana. Third, coefficients to adjust damages for the relative avidity of our sample with respect to the population of Montana anglers are calculated. Fourth, comparisons are made between existing data and our estimates of total trips to all rivers and streams in Southwestern Montana and to the six impacted sites in the Clark Fork Basin to validate the use estimates. Finally, aggregate estimates of summer damages are calculated by multiplying the total number of anglers active in the region by the average damages for the study sample adjusted by the avidity coefficient.

7.4.1 Total Number of Montana Anglers

The total number of resident anglers was derived using all-season licenses and 75 percent of multi-purpose licenses that allow fishing (McFarland, 1993). The multi-purpose categories that allow fishing include the sportsman license, the disabled conservation license, and the "pioneer" license.[4] In 1991, this results in a total of 204,123 resident anglers. Data for 1992 will not be available until after this report is completed, so we assume there were the same number of licenses in both years, and in every year thereafter (see Chapter 9.0).

Estimating the number of nonresident anglers is slightly more difficult because nonresidents can purchase either a season fishing license or one or more two-day licenses. The State of Montana Department of Fish, Wildlife and Parks reports that, on average, nonresidents who purchase two-day licenses buy two per year (McFarland, 1993). To calculate the total number of nonresident anglers, all season licenses are added to half of the two-day licenses sold. Also included are 30 percent of nonresident multi-purpose licenses, which include big game and deer combination licenses that allow fishing (McFarland, 1993). In 1991, this results in a total of 109,696 nonresident anglers.

[4] The pioneer license allows people 12-14 years of age and over 62 to fish. Pioneer licenses have been a subset of resident conservation licenses since 1976. Before that year, they were a separate category. A three-year average over 1989, 1991, and 1992 indicates 48 percent of conservation licenses are pioneer licenses. Therefore, 75 percent times 48 percent of resident conservation licenses are counted as relevant pioneer anglers. Before 1976, 75 percent of pioneer and pioneer conservation licenses are counted (damage estimates for other years are reported in Chapter 9.0). The proportions of conservation licenses that were pioneer licenses between 1976 and 1981 is unclear. We extrapolated from 1975 to 1982 in Chapter 9.0.

7.4.2 The Proportion of All Anglers Who are Active in Stream Fishing in Southwestern Montana

The average angler damages in the sample apply to anglers who are active in river and stream fishing in Southwestern Montana. To estimate the number of applicable anglers in the population requires an estimate of the share of anglers who are active in river and stream fishing in Southwestern Montana.

According to a recent statewide survey that can be segregated by county, at least 42.7 percent of resident license holders purchased licenses in Southwestern Montana (McFarland and Brooks, 1993). It is highly likely that licenses purchased in the area are associated with fishing in the area. However, many anglers purchasing licenses in other areas of the state are also likely to fish in Southwestern Montana. Therefore, we believe a conservative estimate of the percentage of licensed anglers in the state who fish in Southwestern Montana is 45 percent. Additionally, 77.5 percent of resident anglers in Southwestern Montana prefer to fish streams or to fish both lakes and streams (McFarland and Brooks, 1993). These statistics imply that about 34.9 percent (45 percent times 77.5 percent) of the resident anglers are active in river and stream fishing in Southwestern Montana. Therefore, we estimate there were 71,239 (204,123 times 34.9 percent) resident anglers active in river and stream fishing in Southwestern Montana in 1991.

Comparable figures on license purchases and fishing preferences are not available for nonresidents who fish in Montana. Consequently, we compute the percent of nonresident Montana anglers who are active at Southwestern Montana rivers and streams based on the resident statistics discussed above and fishing pressure statistics for residents and nonresidents. Salmonid rivers and streams in Montana Wildlife Regions 2 and 3, which are included in our study area, receive 23.2 percent of all fishing pressure (in days) in Montana for residents and 39.7 percent of all fishing pressure for nonresidents (McFarland, 1989; McFarland, 1992).[5] Our study area also includes a portion of Region 4 and a small portion of Region 1, which in the sample account for approximately 15 percent of sample trips. We increase the Regions 2 and 3 pressure estimates by 15 percent to account for the portions of Regions 1 and 4 in our area and estimate that 26.6 percent of all resident fishing pressure and 45.7 percent of all nonresident fishing pressure is at salmonid streams in Southwestern Montana.

These pressure figures understate the percent of active anglers in a region as, for example, anglers active in the region might only take half of their trips in the region or they might spend half of their time fishing on lakes. In this example, pressure

[5] "Salmonid" rivers and streams are cold water and provide habitat for trout. All of our 26 intensively studied sites are salmonid rivers and streams, as are the great majority of the rivers and streams in Southwestern Montana. These figures were calculated as a five-year average for 1982 through 1985 and 1989.

proportions would understate the percent of anglers active in the region by about 50 percent. To use the pressure figures to estimate the percentage of nonresident anglers active at rivers and streams in Southwestern Montana, we scale the nonresident pressure estimate up by the ratio of the percent of resident anglers who are active in river and stream fishing in Southwestern Montana to the pressure percentage for residents (34.9 percent/26.6 percent = 1.3), or 1.3 times the 45.7 percent of nonresident statewide fishing pressure at rivers in the study area, which equals 59.9 percent of nonresident anglers active in the study area. For 1991, we estimate there were 65,708 (109,696 times 59.9 percent) nonresident anglers active in river and stream fishing in Southwestern Montana.

7.4.3 Adjusting for Relative Avidity

The study sample from our survey may reflect anglers who are more active in fishing than "typical" Montana anglers due to selection bias in obtaining the sample. In essence, more active anglers may be more likely to be intercepted in the study, or to participate in the follow-up survey waves. If this is the case, anglers in this study's sample would have higher damages than average anglers.[6] This can be corrected by adjusting damages downward by the ratio of fishing frequency for all anglers active at Southwestern Montana rivers and streams relative to fishing frequency for those anglers in the study sample.

The forthcoming Montana state volume of the 1991 National Survey of Hunting and Fishing is our best source for comparison of the sample to population avidity because it reports the only data available on average number of trips taken by the population of Montana anglers (Aiken, 1993).[7] The 1991 National Survey reports that the average resident angler in Montana takes 9.50 trips per year. It also reports 301,000 nonresident trips and 178,000 nonresident anglers for 1991. We believe that each nonresident two-day license is treated as a separate angler in the National Survey data instead of the two-day license total being divided by two as is recommended by the Montana Department of Fish, Wildlife and Parks. This results in an over-estimate of 78,000 anglers. Assuming the average two-day license buyer (who buys two two-day licenses per year) takes 1.5 trips (half take one trip and half take two trips), we calculate that the National Survey overestimates the number of trips by 117,000. Adjusting for this discrepancy, an accurate figure for the average number of trips per year taken by nonresidents is 1.84. This

[6] Simple regression analysis demonstrates that there is a very strong linear relationship between anglers' willingness to pay for higher expected catch rates at the impacted sites and their total number of trips under current conditions. Thus, damage estimates for the sample can be adjusted to reflect damages to the population by multiplying the sample estimates of damages by an "avidity coefficient," which is the ratio of average number of trips taken by the population of Montana anglers to the average number of trips taken by our sample. The avidity coefficient is also used in Section 7.4.4 to predict total use in Southwestern Montana and at specific sites.

[7] All other data report use in fishing days instead of trips. Our study is in terms of fishing trips.

reflects that season license holders take more trips than do purchasers of two-day licenses. However, the National Survey estimates of average number of trips include trips to both lakes and streams, and trips for the entire year instead of only for our season defined as May through September. As a result, the National Survey averages must be adjusted downward for river fishing versus all fishing and for the season before they can be compared to averages for our sample.

We are interested in what percentage of trips taken by the population of anglers who are active in river and stream fishing in our region are to rivers and streams as opposed to lakes because our sample data only include information on river and stream fishing trips. This figure can be estimated using the fishing preference percentage discussed in Section 7.4.2. Using that data, and assuming that those who prefer both streams and lakes fish one-half of their trips at each, it is estimated that 76.8 percent of our anglers' trips are to rivers and streams.[8] We assume the same adjustment applies to nonresidents. To compare the National Survey results to our sample results, the National Survey averages must be adjusted by multiplying them by these percentages also. The National Survey estimates of average number of total trips is multiplied by this percentage to calculate the average annual number of river or stream trips. These are 7.30 (9.50 × 76.8 percent) for residents and 1.41 (1.84 × 76.8 percent) for nonresidents.

An adjustment must also be made to calculate the proportion of trips that occur from May through September. Approximately 72 percent of resident salmonid stream fishing pressure in our region and 95 percent of nonresident pressure occurs during our summer season (McFarland, 1989; McFarland, 1992).

The avidity coefficient for residents is calculated by first multiplying the annual number of trips for the population by the season adjustment and the river-only adjustment, yielding an average of 5.25 summer fishing trips to rivers for the population of resident anglers. Dividing 5.25 by our sample predicted average of 17.62 river and stream trips in the summer results in an avidity coefficient of 0.30 for residents (i.e., the average resident angler is 30 percent as avid as those in our sample). Nonresidents in our sample take 3.80 river fishing trips per year. Making similar adjustments for nonresidents, the average number of summer fishing trips to rivers for the population of nonresidents who are active in our region is 1.34, which divided by 3.80 yields an avidity coefficient of 0.35 for nonresidents.

7.4.4 Comparison with Use Estimates from Other Sources

Results from the recreation demand model corrected for sample avidity in all aggregate calculations can be used to predict total use for Southwestern Montana and for the six

[8] 41.5 percent prefer rivers and 36 percent prefer both. (41.5/77.5 + 18/77.5) = 76.8 percent of these individual's trips are to rivers and streams.

impacted sites for comparison with use estimates from other existing data. Our model's predictions of use in Southwestern Montana and at the Clark Fork Basin are similar to estimates from other sources. Our prediction of total use for Southwestern Montana is equal to the number of anglers active in our region times the average number of trips by these anglers (adjusted by the avidity coefficient) times the model predicted proportion of all river trips that are within the four regions of Southwestern Montana. Our estimates are 371,297 trips for residents and 55,144 trips for nonresidents during our season in 1992.[9] The Montana Department of Fish, Wildlife and Parks salmonid stream pressure estimates for our region during the summer season are 376,385 angler days for residents and 233,872 angler days for nonresidents (McFarland, 1989; McFarland, 1992).[10] If we assume that residents spend one day per trip and nonresidents spend 4.66 days per trip,[11] the total trip estimates are 376,385 trips for residents and 50,187 trips for nonresidents, which are virtually identical to our estimates.

Further, our estimate of the current total number of trips to the six impacted sites in the upper Clark Fork River Basin is very close to Hagmann's estimate of use on the Clark Fork River and Silver Bow Creek in 1978. Adjusting for trips to tributaries of the Clark Fork River, Hagmann (1979) estimates approximately 20,000 total trips to our six impacted sites during our season. We can use our model's results to predict 22,378 resident trips and 1,554 nonresident trips to the six impacted sites under current conditions.[12] Our total is only 20 percent higher than the Hagmann estimate, which is over 14 years old.

---

[9] For residents, the calculation is: 71,239 anglers active in the region × 17.62 trips on average × 30 percent correction for avidity × 98.6 percent of all trips predicted by the recreation demand model to be in Southwestern Montana = 371,297 total trips.

For nonresidents, the calculation is: 65,708 anglers active in the region × 3.80 trips on average × 35 percent correction for avidity × 63.1 percent of all trips predicted by the recreation demand model to be in Southwestern Montana = 55,144 total trips.

[10] These pressure estimates are five year averages (1982 through 1985 and 1989) for the total number of salmonid river and stream angler days for Regions 2 and 3 scaled up by 15 percent to account for the portions of Regions 1 and 4 that are part of Southwestern Montana.

[11] 4.66 days per trip = (233,872 total days/59,288 nonresident anglers (another five-year average over the same years))/(1.34 trips per angler × 63.1 percent (the predicted proportion of nonresident trips that are within Southwestern Montana)).

[12] For residents, the calculation is: 71,239 anglers in our region × 17.62 trips on average × 30 percent (avidity adjustment) × 71.0 percent (model predicted share to the 26 sites) × 8.37 percent (share of Clark Fork and Silver Bow trips of all trips to the 26 sites) = 22,378 trips.

For nonresidents, the calculation is: 65,708 anglers in our region × 3.80 trips on average × 35 percent (avidity adjustment) × 58.1 percent (model predicted share to the 26 sites) × 3.06 percent (share of Clark Fork and Silver Bow trips of all trips to the 26 sites) = 1,554 trips.

7.4.5 Estimates of Damages for Summer 1992

Multiplying the estimates of the number of anglers who fish in Southwestern Montana by our predictions of changes per angler in trips to the impacted sites, and by the average damages per angler (both adjusted for avidity), leads to the following aggregate estimates for the summers of 1991 and 1992.[13]

- If the sites were not injured, in both 1991 and 1992 resident anglers would have taken 26,396 more trips to the impacted sites and 25,553 fewer trips to other sites in Montana. Applying the mean resident annual damages of $75.28, times 0.30 for the avidity correction, to the 71,239 affected existing anglers results in seasonal damages of $1,609,000.

- The comparable estimates for nonresidents are 4,861 more trips to the impacted sites and 4,656 fewer trips to other sites. Applying the mean nonresident annual damages of $13.25, times 0.35 for the avidity correction, to the 65,708 affected existing anglers results in seasonal damages of $305,000.

- For both residents and nonresidents, there would have been 31,257 more trips to the upper Clark Fork River and Silver Bow Creek in the summers of 1991 and 1992 if there had been no injuries. The total seasonal damages for both residents and nonresidents are estimated to be $1,914,000 per year.

[13] Recall the number of licenses for 1992 is assumed to be equal to the number of licenses for 1991.

8.0 NONFISHING RECREATION DAMAGES

8.1 INTRODUCTION

In this chapter we address nonfishing recreation damages along the upper Clark Fork River and Silver Bow Creek due to natural resource injuries. Nonfishing recreation along river corridors includes activities such as rest and relaxation, walking or hiking, observing wildlife, biking, RV camping, recreational boating, hunting, and other activities. River corridor natural resource quality is an important component of the aesthetic pleasure of many of these nonfishing recreation activities.

The release of hazardous substances and many of the same natural resource injuries that impact the fishing experience also impact the quality and quantity of nonfishing recreation. Injured water quality, injured fisheries and other aquatic life, contaminated streamside soils, reduced vegetation, and reduced wildlife can directly impact the ability of natural resources along the upper Clark Fork River and Silver Bow Creek to provide nonfishing recreation service flows, and therefore result in compensable use value damages. For example, the streamside tailings that impact the fishery also reduce vegetation and the desirability of a site for nonfishing recreation.

About one-third of parties with anglers include nonfishing recreators. Additionally, about one-half of parties with nonfishing recreators include anglers. As a result, natural resource injuries that affect the selection of a site for fishing visits also indirectly affect the selection of a site for many nonfishing recreation visits.

The analysis uses a simple approach to address nonfishing recreation along river corridors. First, we compute and analyze the ratio of changes in nonfishing recreation visits to changes in fishing visits. Next, this ratio is multiplied by the change in fishing visits to the impacted sites under baseline conditions to estimate the change in nonfishing visits to the impacted sites under baseline conditions. Finally, the change in nonfishing recreation visits is valued using a unit value approach.

The damage assessment is limited to nonfishing recreation along the upper Clark Fork River and Silver Bow Creek river corridors. The assessment is conducted for the period of May through September 1992, so the damages are for the summer season. The omission of consideration to nonfishing recreation damages during other months of the year is addressed in Chapter 9.0. Other nonfishing recreation impacts in lowland and upland areas away from the immediate river corridor are not quantified, and this omission results in a downward bias in the damage estimates.

8.2 THE IMPORTANCE OF NONFISHING RECREATION

Nonfishing recreation is an important activity in Montana. Statewide estimates of nonfishing recreation are available from the 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, and recreation use data are available by region within the state (U.S. DOI, 1989). Hunting is a popular activity in our region, as shown in Table 8-1. In addition, according to the 1985 National Survey for the State of Montana, 241,000 people observed wildlife; 219,400 people fed wildlife; and 64,100 people took pictures of wildlife. Frost and McCool (1986) reported that 41.9 percent of all respondents to the Montana Outdoor Needs Survey hunted during the period from September 1, 1984 through August 31, 1985 in Montana Fish, Wildlife and Parks Region 2, which is the region surrounding Missoula that includes a portion of the Clark Fork Basin.

Table 8-1
1985 Montana Regional Hunting Participation*

	Region 2**	Region 3**
Hunting participation	19,500	40,900
Hunting days	175,500	791,400
Hunting trips	182,800	643,000
Big game participation	17,700	39,100
Big game days	112,000	294,900
Big game trips	98,100	236,000

* Source: 1985 National Wildlife Recreation Survey: Montana.
** Region 2 and Region 3 constitute most of the SW region of Montana.

Many other nonhunting activities also occur in Montana, and many of these activities take place along rivers and streams (BBER and UMT, 1989; Hagmann, 1979). These activities include rest and relaxation, walking, hiking, jogging, bird watching, nature study and photography, mushroom or berry picking, biking, RV camping, horseback riding, and boating.

Hagmann (1979) conducted a study from June 1, 1978 through May 31, 1979 to determine the nature and extent of recreation activities along the upper Clark Fork River between the confluence of Warm Springs and Silver Bow Creeks downstream to Missoula. The Little Blackfoot River, Flint Creek, Rock Creek, and the area adjacent to the Anaconda Company Settling Ponds were included in the study area. During this one-year period, Hagmann estimated there were 102,631 recreation visits, including fishing, in

the study area.[1] Approximately 80 percent of these trips were in the summer (June 1 through September 4), approximately 30 percent were at private campgrounds, and approximately 69 percent of trips were by Montana residents. A summary of the estimated recreation visits for each primary recreation activity is provided in Table 8-2.

During summer months the ratio of nonfishing to fishing visits at the four Clark Fork Basin river sites in the Hagmann study is 1.24, which indicates that 24 percent more visits occur along river corridors at the Clark Fork Basin study sites for the purposes of nonfishing recreation than occur for the purpose of fishing. This ratio excludes recreation at private campgrounds along the upper Clark Fork River, which, if included, would likely increase the ratio as fishing is often only one of several recreation activities at these campgrounds.

8.3 NEW NONFISHING RECREATION DATA

Several data collection efforts were conducted in 1992 that provide additional information on nonfishing recreation along the Clark Fork River and along other river segments in the upper Clark Fork Basin. Most of these data were collected as part of the Southwestern Montana Recreational Fishing (SMRF) study, as discussed in other chapters of this report.

1992 Postcard Study

As part of this study, a postcard survey was conducted of recreator parties along 26 river segments in Southwestern Montana (see Section 2.3). Postcards were left on vehicles encountered along the intercept survey agent's route. On the postcard the respondent reports the recreation use at the site for all members of the party, separated into fishing and nonfishing activities. We use these data to compute the ratio of nonfishing trips to fishing trips along river corridors in Southwestern Montana.

Across all study sites, 32.3 percent of individual anglers reported in the postcard survey data were accompanied by nonanglers. Therefore, natural resource injuries that alter the selection of fishing sites will concurrently impact the selection of sites for many nonfishing recreators. About 30.5 percent of all postcards were from nonfishing parties with no anglers, and 45.5 percent of postcards were returned by anglers with no nonfishing recreators. The remaining 24 percent of postcards were returned by parties with members engaged in fishing and nonfishing recreation. As a result, over 54 percent of recreator parties at the intercept sites included nonfishing recreators.

[1] Hagmann's estimates are for "visits" rather than "days."

Table 8-2
1978 Participation Estimates for Upper Clark Fork River Study Area*

Activity	Summer Visits (June 1, 1978 - September 4, 1978)	Winter Visits** (September 5, 1978 - May 31, 1979)
Public Sites		
Fishing	23,366	7,632
Float fishing	1,565	58
Rest or relaxation	2,571	523
Walking	279	262
Picnicking	2,236	363
Sightseeing	894	0
RV camping	13,470	872
Water play	3,857	58
Photography	56	102
Tent camping	3,577	582
Floating	1,900	262
Nature study	56	218
Mushroom or berry picking	280	0
Trail biking	671	0
Hunting (total)	168	3,344
Big game		58
Waterfowl		3,068
Upland game birds		218
Other	950	262
Totals		
Public Sites	55,894	14,538
Private Campgrounds	26,529	5,670
Public and Private	82,423	20,208

* Source: page 64, Hagmann (1979). Private campground use is not disaggregated by activity type. These figures do not include recreation use at Rock Creek.

** Winter use not estimated at Flint Creek, Little Blackfoot River, or Warm Springs Creek.

Additional results from the postcard survey are provided in Tables 8-3 and 8-4. The study finds that parties with nonfishing recreators are typically larger than fishing-only parties (Table 8-3). Average time at the site varies by month from about 4.6 hours to 6.2 hours per fishing visit and from about 3.6 to 5.8 hours per nonfishing recreation visit. The primary nonfishing activities included pleasure boating and other water activities (40 percent); camping and other bank activity (11 percent); picnicking, painting, walking, hiking, and jogging (8 percent); and other, including those who indicated they were involved in a nonfishing activity but did not indicate the specific activity (41 percent).[2]

The ratio of nonfishing to fishing recreation visits varies across sites, as reported in Table 8-4. For comparison to Hagmann's results, the ratio is computed for all nonfishing activities for the comparable sites on the Clark Fork River (UCF 1 through UCF 5, Little Blackfoot, Flint Creek, and Rock Creek); it is 1.05. The difference between the nonfishing to fishing ratio in Hagmann (1.24) and in the 1992 postcard study (1.05) can be attributed to differences in site definitions, the study year, and sampling methods. The same ratio for all sites in the 1992 postcard survey is 0.98, and for just the injured Clark Fork sites it is 1.50. The higher ratio at the injured sites may reflect that fishing has been impacted to a greater degree by injuries at these sites than has nonfishing recreation.

The sampling method in the 1992 postcard survey is likely to understate nonfishing recreation along river corridors. The postcard intercept sites were primarily selected to support the analysis of fishing recreation. Sites that might be more frequently visited by nonfishing recreators were not necessarily included in the postcard survey plan. As a result, the data from the postcards can be expected to understate the number of nonfishing recreators *vis-à-vis* fishing recreators along rivers in Southwestern Montana, and to lead to understated damage estimates for nonfishing recreation.

1992 Boating Study

During 1992, a recreational boating survey was conducted as part of this study. This study was completed by boaters (primarily float trips intercepted at put-in or take-out points) concurrent with the fishing intercept survey. The survey includes 89 boaters who indicated that they were not fishing from their boats. These nonfishing boat-trip interviews occurred primarily along the Missouri, Madison, and Blackfoot rivers. The survey instrument is found in Appendix 8A. While floating, many individuals were involved in a number of other activities, as summarized in Table 8-5. Many of these activities would be affected by the types of natural resource injuries that currently occur along the upper Clark Fork River and Silver Bow Creek.

[2] The activity for those who failed to write it in is likely to be any of the listed activities except recreational boating, because boating is explicitly listed on the postcard survey.

Table 8-3
Average Party Size

River	All Postcards	Postcards with Fishing Only Parties	Postcards with Nonfishing Only Parties
UCF 1	2.526	1.829	3.032
UCF 2	2.375	1.444	2.650
UCF 3	3.500	2.500	4.600
Middle CF	2.888	1.870	3.270
Rock Cr.	2.591	1.960	2.893
Flint Cr.	2.391	1.706	3.000
Bitterroot 1	3.120	1.947	3.137
Bitterroot 2	4.693	2.468	4.385
Lolo Cr.	3.140	1.625	3.200
Blackfoot	3.346	2.222	3.494
L. Blackfoot	1.792	1.571	0.000
UCF 4	2.000	1.333	4.000
UCF 5	3.000	2.750	2.000
Big Hole 1	2.652	2.510	2.833
Big Hole 2	2.989	3.071	2.130
Jefferson 2	2.700	2.244	2.440
Beaverhead	2.958	2.088	6.772
Jefferson 1	2.600	2.368	2.405
Missouri	2.741	2.383	2.765
Yellowstone	3.495	2.222	2.105
Gallatin	2.060	1.662	2.375
E. Gallatin	1.702	1.459	1.750
Madison 1	2.919	1.744	3.384
Madison 2	2.735	2.294	2.692

Source: RCG/Hagler Bailly, 1992 postcard survey. Omitted due to small sample sizes are Warm Springs Creek (1 obs.), Warm Springs Ponds, and Silver Bow Creek (0 obs.).

Table 8-4
Ratio of Nonfishing to Fishing Use
(based on all postcards)

River	Number of Visits			Ratio of Nonfishing to Fishing Visits		
	Total # of Postcards Received	Total # of Anglers	Total # of Nonfishing Recreators	For All Nonfishing Recreation	Excluding Guides and Guided Tours	Excluding Guides, Boating/ Water Activity
UCF 1	76	79	113	1.430	1.380	1.038
UCF 2	32	17	59	3.471	3.471	2.647
UCF 3	10	11	24	2.182	2.182	2.091
Middle CF	125	110	251	2.282	2.264	1.018
Rock CR.	115	148	150	1.014	0.986	0.858
Flint CR.	23	36	19	0.528	0.528	0.528
Bitterroot 1	108	67	270	4.030	3.985	2.866
Bitterroot 2	88	221	192	0.869	0.824	0.412
Lolo CR.	57	36	143	3.972	3.972	3.750
Blackfoot	136	91	364	4.000	3.956	1.747
L. Blackfoot	24	39	4	0.103	0.103	0.103
UCF 4	4	4	4	1.000	1.000	1.000
UCF 5	12	28	8	0.286	0.286	0.286
Big Hole 1	92	178	66	0.371	0.337	0.174
Big Hole 2	94	183	98	0.536	0.481	0.279
Jefferson 2	90	144	99	0.688	0.667	0.361
Beaverhead	119	201	151	0.751	0.721	0.622
Jefferson 1	75	75	120	1.600	1.573	0.987
Missouri	251	469	219	0.467	0.450	0.134
Yellowstone	95	198	134	0.677	0.626	0.162
Gallatin	133	125	149	1.192	1.176	0.816
E. Gallatin	47	60	20	0.333	0.333	0.250
Madison 1	149	127	308	2.425	2.378	1.000
Madison 2	268	552	181	0.328	0.216	0.132
Total	2,223	3,199	3,146	0.980	--	--

Source: RCG/Hagler Bailly, 1992 postcard survey. Omitted due to small sample sizes are Warm Springs Creek (1 obs.), Warm Springs Ponds, and Silver Bow Creek (0 obs.).

Table 8-5
Summary of Boating Intercept Survey*

	Activity/Category	Number Who Participated (number who answered the question)
A.	Stated that floating was the primary purpose of the trip	73 (85)
B.	Other activities engaged in (multiple activities allowed)	-- (63)
	Birdwatching	30
	Camping	13
	Hiking	6
	Picnicking	27
	Swimming	29
	Wildlife viewing	42
	Doing "other" activity	2 - Photography 4 - Floating 2 - Fishing
C.	Montana residents	69 (75)

* Based on recreation boating intercept survey of 89 individuals at 26 river segments chosen for the recreational fishing analysis.

End-of-Season Mail Survey

As part of the fishing study, a mail survey was completed at the end of the summer season by anglers (see Chapter 2.0 for discussion and Appendix 2A for a copy of the survey instrument). Recreators who are not anglers are not included in this survey. Anglers rated the quality of nonfishing recreation as less important to the selection of a fishing site than other site characteristics presented to them (Table 3-1), although nonfishing is still ranked in the middle of the importance scale. Because most anglers (about two-thirds in the postcard survey) are not accompanied by nonfishing recreators on their fishing trips, it is reasonable that fishing characteristics of a site would be more important to the selection of a site than nonfishing characteristics of a site.

The correspondence between the quality of fishing and nonfishing recreation at river sites is apparent in the survey data. As reported in Table 3-4, ratings by anglers of seven selected sites for nonfishing quality are highly correlated with the ratings of the sites in terms of perceived catch rates. Combined Upper Clark Fork 2 and 3 and Upper Clark Fork 4 are rated as the worst two of the seven sites for both fishing and nonfishing recreation (Questions 4 through 7).

1992 Bitterroot Flyovers

During 1992, the Montana Department of Fish, Wildlife and Parks conducted regular flights over the Bitterroot River and took aerial photographs from which recreation counts were made.[3] The photographs are sufficiently detailed to allow classification of individuals as either bank anglers, float anglers, or those on nonangling float trips. Those individuals engaged in nonfishing bank recreational activities were not counted. The ratio of nonfishing float trip visits to all fishing visits ranged from 2 to 12 depending on the time of year. If other nonfishing recreation activities were included, the ratio of nonfishing to fishing recreation would be even higher. This again provides support that nonfishing recreation is important along river corridors in Southwestern Montana.

8.4 COMPUTING CHANGE IN NONFISHING RECREATION USE ALONG THE INJURED RIVER CORRIDORS UNDER BASELINE CONDITIONS

In this section we compute the change in nonfishing recreation trips along the upper Clark Fork River and Silver Bow Creek. First, we compute and analyze the ratio of the change in nonfishing recreation trips to the change in fishing trips. This analysis is based on simple comparisons of fishing and nonfishing trip-taking behavior and regression

[3] This information was obtained from Mr. Dennis Workman, Montana Department of Fish, Wildlife and Parks.

analysis, both using the postcard data. The ratio is applied to the increase in fishing trips to the impacted sites under baseline conditions (from Chapter 7.0) to estimate the increase in nonfishing recreation trips to the impacted sites under baseline conditions.

Comparison of Ratios Method

A simple comparison of nonfishing to fishing ratios at sites in the Southwestern Montana region can be used to infer the change in nonfishing trips for a change in fishing trips to the injured sites. At the impacted Clark Fork River and Silver Bow Creek sites, the ratio of nonfishing to fishing trips is 1.5. The same ratio for the uninjured sites (all other sites) in the region is 0.96. The difference in the ratio between the injured and uninjured sites indicates that fishing trips to the injured sites may be affected more by injuries than are nonfishing trips. If in baseline conditions the ratio at the impacted sites were to be the same as at the average of all other sites, then the ratio of the change in nonfishing to the change in fishing will be less than 0.96 (so that the current average of 1.5 is decreased to 0.96 after the sites are returned to baseline conditions, reflecting that fishing trips will increase by more than nonfishing trips). Using this logic, we can compute the ratio for the change in nonfishing to the change in fishing at the impacted sites as follows (trips are rounded to the nearest 100):

1. In Section 7.4.4 we estimated current fishing trips (in 1992) to the impacted sites of 23,900. If current nonfishing recreation is 1.5 times current fishing recreation, then there are currently 35,900 nonfishing recreation trips to the impacted sites.

2. In Section 7.4.5 we estimated an additional 31,300 fishing trips to the impacted sites under baseline conditions, for a total of 55,200 fishing trips. If under baseline conditions the ratio of nonfishing to fishing recreation trips is 0.96, then the number of nonfishing trips under baseline conditions is 53,000 (55,200 $\times$ 0.96).

3. The estimated change in nonfishing recreation trips is 17,100 (53,000 - 35,900). The ratio of the change in nonfishing recreation trips to the change in fishing trips is therefore approximately 0.55 (17,100/31,300).

Regression Methods

Using the 1992 postcard survey data, alternative ratios of nonfishing recreation visits to fishing recreation visits are estimated based on two sets of data.

1. Postcard data for all fishing and nonfishing visits. This ratio can then be applied to the change in all fishing visits to estimate the change in all nonfishing recreation visits.

2. Postcard data for only those parties with both fishing and nonfishing members. This ratio can then be applied to the 32.3 percent of fishing visits where nonfishing recreators accompany the anglers to estimate the change in the number of nonfishing recreation visits accompanying increased angler visits.

Regression models are used to explain nonfishing trips to the sites included in the postcard intercept survey (some of the 26 sites were deleted due to lack of sufficient observations) and are reported in Table 8-6. Models 1 and 2 explain the number of nonfishing visits to a site as a function of fishing visits to the site and other site characteristics. Model 3 is discussed below. In Models 1 and 2 the coefficient on "Fishing Trips" is the estimated rate of change in nonfishing visits for a change in fishing visits to the site. Also included in the regressions are "Flow," which is the average summer flow at the site; "Campground," which equals 1 if a large campground is present at the site, and equals zero otherwise; and "Gravity," which is the population of the nearest large city divided by the distance of this city from the site.[4]

Other variables such as "Campground" are included because they may not change just because natural resource quality is returned to baseline conditions, and therefore they are held constant in the analysis. However, as sites are improved there will be increased pressure to improve access and facilities to support public use of the natural resources, which will enhance the desirability of the sites for nonfishing recreation. By including "Campground," the growth in such facilities has been fixed at zero in the analysis, which results in conservative estimates of increased nonfishing recreation at the Clark Fork River and Silver Bow Creek.

Regression Models 1 and 2 are statistically significant, as is the level of fishing trips in explaining the level of nonfishing recreation in these two models. Model 1 is based on data for all anglers and nonfishing recreators in the postcard sample. The coefficient on fishing trips (0.41) indicates that for each 100 additional fishing trips, an additional 41 nonfishing recreation trips are expected to occur. This estimate is less than the prior 0.55 estimate in part because the presence of a campground and other site characteristics are held constant.

Model 2 is based on the postcard data for parties with both anglers and nonfishing recreators. This model is very significant and indicates that, for parties with both fishing and nonfishing members, each additional fishing trip results in 0.93 additional nonfishing recreation trips. Given that about 32.3 percent of anglers are accompanied by nonfishing recreators, for every 100 additional fishing trips there will be about 30 nonfishing

[4] Catch rate at the site is not included in Models 1 and 2 because the number of anglers at the site depends on this variable and is already modeled in the multinomial logit fishing model.

Table 8-6
Nonfishing Recreation Trip Regression Results

Variable	Estimated Coefficient (t-ratio)		
	Model 1 All Postcards	Model 2 Postcards with Both Fishing and Nonfishing Recreation Members	Model 3 All Postcards
Dependent Variable	Nonfishing Recreation Trips*	Nonfishing Recreation Trips*	Ratio of Nonfishing Trips to Fishing Trips
Constant	0.14 (0.93)	-0.01 (-0.37)	1.07 (1.52)
Fishing trips*	0.41 (2.28)**	0.93 (13.05)**	
Flow	4.94 E-5 (0.77)	3.20 E-6 (0.42)	-5.78 E-5 (-0.58)
Length			0.04 (1.46)
Gravity	-1.44 E-8 (-0.08)	-4.24 E-9 (-0.23)	
Campground	0.15 (0.63)	0.06 (2.30)**	1.56 (3.28)**
Expected catch rate			-1.56 (-1.55)
R^2 F value # Observations	0.37 3.00 25	0.95 78.6 23	0.56 6.33 25

* Fishing and nonfishing are per mile and per interviewer visit to the site.
** Coefficient is significant at the 1 percent level.

recreation trips by individuals accompanying anglers (100 additional fishing trips × 0.323 with nonfishing members × 0.93 change in trips by nonfishing members = 30). The results of Model 2 indicate that improvements in fishing quality, which lead to increased fishing trips to a site, have a direct and significant effect on the number of nonfishing recreation trips taken to the site as well. The results of Model 2 indicate that the change in nonfishing by members of parties with both anglers and nonfishing recreators is about 55 percent (using the simple ratio analysis) to 74 percent (using regression Model 1) of the change in all nonfishing trips.

Model 3 explains the ratio of nonfishing visits to fishing visits at a site in terms of site characteristics. Expected catch rate (ECR) is included as increased catch rates are likely to have a greater impact on attracting anglers as compared to attracting nonfishing recreators, which would reduce the nonfishing to fishing ratio. Again, this model is statistically significant. ECR has the expected sign but is only significant at a moderate level of statistical confidence. Model 3 can be used to predict the change in nonfishing recreation for a change in fishing recreation due to changes in ECR by assuming all site characteristics are constant except for ECR. The predicted change in ECR per hour for the upper Clark Fork and Silver Bow Creek sites is 0.264 (weighted by river miles using data in Table 6-5). The current nonfishing to fishing ratio at these sites is 1.5 (see Table 8-4). The imputed change in nonfishing recreation can be derived to be equal to 0.77 times the change in fishing activity expected at these sites,[5] which is substantially larger than the Model 1 result.

Applications

We have considered several methods to evaluate the change in nonfishing recreation to the change in fishing recreation at the impacted sites when they are returned to baseline conditions. We select the ratio of 0.55 for this analysis. This estimate is derived from the simple comparison of existing nonfishing to fishing ratios, and is between the 0.41 estimate from regression Model 1, which we believe understates the likely change in nonfishing recreation, and the 0.77 estimate from regression Model 3. Further, based on regression Model 2, over half of this change results from nonanglers who accompany anglers.

---

5 Let F = fishing activity, NF = nonfishing activity, ΔF = change in fishing activity, ΔNF = change in nonfishing activity, and subscripts 1 and 2 refer to the current and baseline scenarios.

Then:
(1) $NF_1/F_1 = 1.5$.
(2) $NF_2/F_2 = 1.5 - 1.565 \times (\text{Change in ECR} = 0.264) = 1.087$.
(3) $\Delta NF = NF_2 - NF_1 = 1.087 \times F_2 - 1.5 \times F_1 = 1.087 \times (\Delta F + F_1) - 1.5 \times F_1$
$= 1.087 \times \Delta F - 0.413 \times F_1$
$= 1.087 \times \Delta F - 0.413 \times \Delta F \times (F_1/\Delta F)$.
(4) If $F_1/\Delta F = 23{,}932/31{,}257$ (from Chapter 7.0) $= 0.766$, then $\Delta NF = 0.77 \times \Delta F$.

Under baseline natural resource conditions, 31,257 additional angler trips are estimated to occur along the upper Clark Fork River and Silver Bow Creek in summer 1992 (see Section 7.4.5). Applying our central estimate of the nonfishing to fishing ratio predicts the addition of 17,192 nonfishing recreation trips under baseline resource conditions in 1992 (17,192 = 31,257 × 0.55). This includes 9,389 additional nonfishing recreation trips by individuals accompanying anglers plus 7,803 additional nonfishing recreation trips by individuals unaccompanied by anglers.

If the percent of new nonfishing recreation visits versus visits that are substituted from other sites is the same as for fishing visits, then approximately 97 percent of the additional nonfishing recreation visits are visits that would have otherwise been taken to other sites, and approximately 3 percent of the increase in nonfishing recreation visits are new nonfishing recreation trips.

8.5 ECONOMIC VALUATION OF NONFISHING RECREATION AND CALCULATION OF DAMAGES

The valuation of nonfishing recreation impacts uses the considerable literature on nonfishing recreational use values to select a per-trip value to be applied to the change in nonfishing recreation trips to the sites under baseline conditions. This methodology may be used under both the current and proposed NRDA regulations: "Unit values are preassigned dollar values for various types of nonmarketed recreational or other experiences by the public. Where feasible, unit values in the region of the affected resource and unit values that closely resemble the recreation or other experience lost with the affected resource may be used." [Proposed 43 CFR § 11.83 (c)(2)(ii)(E) and 43 CFR § 11.83 (d)(6).]

Selecting a unit value is complicated by the mix of different nonfishing activities that would occur along the upper Clark Fork River and Silver Bow Creek under baseline conditions, and because the reported values in the literature are from different studies and locations, which may have a different quality of recreation than in Montana. To overcome these issues, the literature is reviewed to develop a ratio of values for nonfishing trips versus fishing trips. As reported in Appendix 8B, a ratio of 60 percent is selected. This means that across many studies the average value of nonfishing trips, for the mix of activities at the impacted sites, is about 60 percent of the average value for fishing trips. In Section 7.3.3 it was reported that the WTP per expected additional fishing trip to the injured sites is $61.22.[6] Applying the ratio of 60 percent, we use a per-trip value for nonfishing recreation of $36.73. The 1992 summer damages to

[6] WTP of $61.22 is an average for both residents and nonresidents weighted by the additional number of trips for each, which are reported in Section 7.4.5.

nonfishing recreators are therefore $36.73 times 17,191 additional nonfishing recreation trips reported in Section 8.4, or $631,000. Based on Hagmann (1979), nonfishing recreation damages for the period of October through April may be as much as 20 percent of annual damages, which is addressed in Chapter 9.0. Past and future damages can computed in a similar manner (see Chapter 9.0 for estimates).

The above analysis provides conservative estimates of nonfishing recreation damages for the following reasons:

- The nonfishing recreation impacts away from the Clark Fork River and Silver Bow Creek river corridors are omitted. These injuries were shown to exist, but are not quantified in the injury assessment.

- The postcard sampling procedure may understate nonfishing recreation *vis-à-vis* fishing recreation. Consequently, our selection of 0.55 as the coefficient relating the change in fishing trips to nonfishing recreation trips is conservative. Using the higher ratio of 0.77 would have resulted in estimates of nonfishing damages that were 40 percent higher.

9.0 AGGREGATE USE AND DAMAGES THROUGH TIME

9.1 AGGREGATE DAMAGES

The injuries to the impacted sites in the upper Clark Fork Basin have existed for many years and will likely continue to exist for many more. Current proposed cleanup activities will take a long time to implement fully, and significant injuries will still remain. For these reasons, it is necessary to estimate damages to anglers and other recreators for the past, present, and future. Based on the request of the State of Montana, we calculate past damages for 1971 through 1992 even though injuries existed before 1971. Present and future damages are computed: (1) for a twelve-year period from 1993 through 2005 assuming cleanup activities would finally result in minimal damages in 2005; and (2) for 1993 in perpetuity assuming injuries are never significantly mitigated. Damages are first estimated for the summer season used in the study. Then, in Section 9.1.4, the summer season estimates are extended to estimate year-round damages.

To determine the present value of total damages, damages incurred before 1993 are converted into their present value by assuming they were invested in the year in which they occurred at a real interest rate of seven percent per year, the real discount rate provided for in the regulations ([43 CFR § 11.84 (e)(2)] and Office of Management and Budget, 1992). For example, the present value of one dollar of damages in 1971 is $4.14, and the present value of one dollar of damages incurred in 1981 is $2.10. At the same time, the present value of each dollar of damages incurred in the future is less than a dollar. For example, the present value of each dollar of damages in 2002 is $0.51, the amount that one would need to invest today at seven percent to have one dollar in 2002. 1993 is the base year used for the calculation of all present values.

9.1.1 Recreational Fishing

Use Through Time

First, we report the estimated loss of summer season site use (loss of recreation service flows) through time calculated by following the same procedures used to calculate the 1992 figures reported in Chapter 7.0. Recall that these estimates are generated by multiplying our estimate of the total number of anglers who fish at rivers and streams in Southwestern Montana by the recreation demand model's predictions of how the average number of trips would differ in the baseline scenario (adjusted for avidity). These estimates are presented in this chapter for all years as far back as 1971.

The first step in deriving aggregate baseline predictions of changes in use over time is to obtain estimates of the number of anglers in each year from 1971 through the present and the future. The derivation of these estimates for 1991 and 1992 is explained in

Chapter 7.0 The estimates for 1982 through 1990 were derived in the same way. The procedure for estimating the number of nonresident anglers from 1971 through 1981 is slightly different because prior to 1982, there were one-day and six-day nonresident fishing licenses, but no two-day licenses. For those years, it was assumed that the number of nonresidents buying one-day licenses is the number sold divided by four, and the number of nonresidents purchasing six-day licenses is simply the number of six-day licenses sold. These assumptions ensure conservative estimates of the number of nonresident anglers for 1971 through 1981.[1] License data for residents were available from 1971 through 1991. Before 1971, the number of licenses for each year could be estimated using the average ten-year population growth rate for Montana. This growth rate could be applied to both residents and nonresidents. For the years 1960 through 1970, the rate was 0.27759 percent per year, and for the years 1949 through 1959, the rate was 1.32897 percent per year (U.S. Bureau of the Census, 1987). For example, the estimated number of licenses in 1970 would be equal to the number of licenses in 1971 divided by 1.0027759. For all years after 1991, we assume the numbers of resident and nonresident anglers remain at the 1991 levels. Alternatively, one could use census population growth projections to proxy the change in the number of licenses sold in the future, which would increase total damages. The historical long-term increase in the number of licenses sold suggests that assuming the number of anglers stays constant in the future leads to a conservative estimate of damages. The same adjustments for region, type of fishing, and avidity that were made for 1991 and 1992 are also made for all years. Our estimates of the total number of resident and nonresident anglers who fish at rivers and streams in Southwestern Montana are presented in Table 9-1 for the years 1949 through 1992.[2]

The increase in the number of summer season fishing trips to the impacted sites in the upper Clark Fork River Basin varies from 24,147 in 1971 to 33,711 in 1983. The model predicts a total of over one million more summer season trips between 1971 and 2005 to impacted sites in the upper Clark Fork River Basin if baseline conditions existed between 1971 and 2005. The seasonal predicted increases in the number of trips to impacted sites for residents and nonresidents in the baseline scenario are reported from 1971 through 1992 in Table 9-2.

[1] These numbers may be revised if more definitive license data from this period are obtained.

[2] Presenting the number of anglers per year for years prior to 1971 allows the calculation of damage estimates in prior years.

Table 9-1
Estimated Number of Anglers Who Fish at Rivers and Streams
in Southwestern Montana (1949-1992)

Year	Resident Anglers	Nonresident Anglers
1992	71,239	65,708
1991	71,239	65,708
1990	71,885	61,893
1989	70,841	58,691
1988	71,509	55,234
1987	75,396	55,030
1986	76,468	52,947
1985	77,623	56,439
1984	78,095	54,369
1983	78,452	62,748
1982	77,677	64,194
1981	75,771	53,861
1980	75,413	45,583
1979	72,383	44,799
1978	70,391	48,061
1977	68,016	46,466
1976	66,478	43,722
1975	62,139	41,466
1974	62,793	39,704
1973	62,136	49,898
1972	58,880	48,887
1971	56,491	43,469
1970	56,335	43,348
1969	56,179	43,228
1968	56,023	43,109

Table 9-1 (cont.)
Estimated Number of Anglers Who Fish at Rivers and Streams
in Southwestern Montana (1949-1992)

Year	Resident Anglers	Nonresident Anglers
1967	55,868	42,989
1966	55,713	42,870
1965	55,559	42,752
1964	55,405	42,633
1963	55,252	42,515
1962	55,099	42,398
1961	54,947	42,280
1960	54,794	42,163
1959	54,076	41,610
1958	53,366	41,064
1957	52,667	40,526
1956	51,976	39,995
955	51,294	39,470
1954	50,621	38,952
1953	49,958	38,441
1952	49,302	37,937
1951	48,655	37,439
1950	48,018	36,949
1949	47,388	36,464

Table 9-2
Net Increase in Summer Season Fishing Trips to Impacted Sites under Baseline Conditions

Year*	Increase in Trips to Impacted Sites by Residents	Increase in Trips to Impacted Sites by Nonresidents
1992	26,396	4,861
1991	26,396	4,861
1990	26,636	4,579
1989	26,249	4,342
1988	26,496	4,086
1987	27,936	4,071
1986	28,334	3,917
1985	28,762	4,176
1984	28,936	4,023
1983	29,069	4,642
1982	28,781	4,749
1981	28,075	3,985
1980	27,942	3,372
1979	26,820	3,314
1978	26,082	3,556
1977	25,202	3,438
1976	24,632	3,235
1975	23,024	3,068
1974	23,267	2,937
1973	23,023	3,692
1972	21,817	3,617
1971	20,931	3,216

* Not shown are trips for years after 1992 because the estimated number of licensed anglers is assumed constant in all years after 1992 at the 1991 level.

Damages Through Time

Summer season damages to anglers caused by the injuries to the six sites were reported in Chapter 7.0 for 1992.[3] The present values of damages from past and future years are calculated in this chapter using the mean WTP estimates (adjusted for avidity) discussed in Chapter 7.0, the total number of anglers for each year from Table 9-1, and a discount rate of 7 percent as discussed in Section 9.1. The present value in 1993 of total past seasonal damages to resident anglers between 1971 and 1992 is estimated to be $81.0 million. Past damages to nonresidents during the same period is estimated to be $12.2 million.

Damages in the future are aggregated for: (1) 1993 through 2005, twelve years into the future; and (2) 1993 in perpetuity under the assumption that injuries are never significantly mitigated. Twelve years is chosen as a conservative estimate of aggregate future damages. Even after twelve years, for example, Silver Bow Creek and the Clark Fork River will not be returned to baseline conditions. The present value of total seasonal damages to resident anglers from 1993 through 2005 is estimated to be $14.4 million, and the total for nonresidents is estimated to be $2.7 million. The total seasonal damages calculated from 1993 in perpetuity are $24.6 million and $4.7 million for residents and nonresidents, respectively. Aggregate seasonal damages for the various time periods are summarized in Table 9-3.[4]

Table 9-3
Total Summer Damages to Anglers ($ 1992, present value 1993)

Time Period	Residents	Nonresidents	All Anglers
Past Damages			
1971-1992	$81.0 million	$12.2 million	$93.1 million
Present and Future Damages			
1993-2005	$14.4 million	$2.7 million	$17.1 million
1993-continuous into future	$24.6 million	$4.7 million	$29.3 million
Total Past, Present, and Future Damages			
1971-2005	$95.4 million	$14.9 million	$110.3 million
1971-continuous into future	$105.6 million	$16.8 million	$122.4 million

[3] The damages for 1992 reported in Chapter 7.0 are not in 1993 present values. All damages in this chapter are in present values using 1993 as the base year.

[4] Damages for separate time periods reported in tables in this chapter may not appear to add up to the total damages for all periods, due to rounding.

9.1.2 Nonfishing Recreation

Use Through Time

As set forth in Chapter 8.0, the losses of summer season nonfishing recreational service flows for all years are computed by applying the ratio of nonfishing to fishing visits (0.55) to the change in the total number of seasonal angling trips to the impacted sites in the baseline (no-injury) scenario for all years.

The increase in the number of seasonal nonfishing recreation trips ranges from 13,281 in 1971 to 18,541 in 1983. The total change in the predicted number of seasonal nonfishing recreation trips to impacted sites in the absence of injuries from 1971 through 2005 is 587,000. The increases in the number of trips by year are presented in Table 9-4.

Damages Through Time

In Chapter 8.0, the damages to nonfishing recreators were estimated for the summer season of 1992 by first estimating the number of additional nonfishing trips to the impacted sites under baseline conditions and then applying a per-trip value of $36.73 based on the literature and per-trip fishing values. The damages for all years from 1971 through the future are estimated in the same fashion.

The present values of annual damages to nonfishing recreators are also calculated using a discount rate of seven percent annually. Total past damages to nonfishing recreators from 1971 through 1992 are estimated to be $30.8 million. The present value of future damages from 1993 through 2005 are estimated to be $5.6 million. If annual damages are assumed to continue indefinitely into the future, aggregate future damages from 1993 forth are estimated to be 9.7 million. Total damages to nonfishing recreators are summarized in Table 9-5.

9.1.3 Total Summer Damages

Total summer damages are calculated by summing the present values of damages to anglers and nonfishing recreators for all years. The present value of all damages to both groups between 1971 and 2005 is estimated to be $146.7 million. Alternatively, if present and future damages are calculated from 1971 in perpetuity, the present value of the total is $162.8 million. Total summer season damages for different time periods are presented in Table 9-6.

Table 9-4
Net Increase in Summer Season Nonfishing Recreation Trips to Impacted Sites under Baseline Conditions

Year*	New Nonfishing Recreation Trips = 0.55 x New Angling Trips
1992	17,192
1991	17,192
1990	17,168
1989	16,825
1988	16,820
1987	17,604
1986	17,738
1985	18,115
1984	18,127
1983	18,541
1982	18,442
1981	17,633
1980	17,223
1979	16,574
1978	16,301
1977	15,752
1976	15,327
1975	14,351
1974	14,412
1973	14,693
1972	13,989
1971	13,281

* Not shown are trips for years after 1992 because the estimated number of licensed anglers is assumed constant in all years after 1992 at the 1991 level.

Table 9-5
Total Summer Season Damages to Nonfishing Recreators ($ 1992, present value 1993)

Time Period	All Nonfishing Recreators
Past Damages	
1971-1992	$30.8 million
Present and Future Damages	
1993-2005	$5.6 million
1993-continuous into future	$9.7 million
Total Past, Present, and Future Damages	
1971-2005	$36.4 million
1971-continuous into future	$40.4 million

Table 9-6
Total Summer Season Damages to Anglers and Nonfishing Recreators ($ 1992, present value 1993)

Time Period	Total Damages
Past Damages	
1971-1992	$123.9 million
Present and Future Damages	
1993-2005	$22.8 million
1993-continuous into future	$38.9 million
Total Past, Present, and Future Damages	
1971-2005	$146.7 million
1971-continuous into future	$162.8 million

9.1.4 Total Full-Year Damages

The aggregation factors first described and calculated in Chapter 7.0 were designed to calculate damages and the increase in the total number of trips during the summer season, from May through September. Recall from Chapter 7.0 that 72 percent of resident stream fishing trips to Southwestern Montana and 95 percent of nonresident trips are taken in the summer season. Annual aggregate damages can be estimated by dividing the summer season estimates by these coefficients.[5] Our annual estimates of damages for the past, present, and future are presented in Table 9-7.

Table 9-7
Total Annual Damages to Anglers and Nonfishing Recreators ($ 1992, present value 1993)

Time Period	Total Damages
Past Damages	
1971-1992	$163.7 million
Present and Future Damages	
1993-2005	$29.9 million
1993-continuous into future	$51.1 million
Total Past, Present, and Future Damages	
1971-2005	$193.6 million
1971-continuous into future	$220.5 million

9.2 SUMMARY

Our estimates of the total recreation damages incurred from 1971 forward due to the injuries to the upper Clark Fork River Basin range from $194 million to $221 million. They are conservative estimates for many reasons including:

[5] A coefficient of 0.80 was used for nonfishing recreation, which is consistent with Hagmann (1979). Alternatively, we could have weighted the resident and nonresident angling coefficients by the increase in the number of trips for the two groups, which would have yielded a coefficient of approximately 0.76 for summer nonfishing recreation trips. Using 0.76 instead of 0.80 would have caused full-year damages for nonfishing recreators to be five percent higher.

- It is generally believed that injuries at the sites, measured by fish stocks, were greater in the years prior to 1992, and therefore past damages from 1971 through 1991 are understated.

- The period over which damages are calculated is shorter than the period of damages. Releases of hazardous substances started as early as the late 1800s.

- These estimates are based only on existing angler populations. No estimate of WTP is made for individuals who do not now fish at rivers and streams in Southwestern Montana but would fish at these sites if the Clark Fork River and Silver Bow Creek were restored to baseline (no-injury) conditions.

- The damage estimates only include estimates of the damages to anglers and nonfishing recreators along river corridors. They do not include the damages to all of the other individuals who visit other impacted sites in Southwestern Montana. In addition, damages due to injuries to the upland soils, vegetation, wildlife, and wildlife habitat in the upper Clark Fork River Basin are not included in our estimates of damages, nor are damages to visitors who pass by but do not stop for extended recreation.

10.0 REFERENCES

Aiken, R. 1993. Personal Communication. Economist, U.S. Department of the Interior. July.

BBER and UMT. 1989. Montana State Park System Visitor Study. Prepared by the Bureau of Business & Economic Research and the University of Montana for Montana Dept. of Fish, Wildlife and Parks, Missoula, MT.

Bockstael, N.E., W.M. Hanemann, and C.L. Kling. 1987. Estimating the value of water quality improvements in a recreational demand framework. *Water Resources Research* **23**(5): 951-960.

Bockstael, N.E., K.E. McConnell, and I.E. Strand. 1991. Recreation. In J.B. Braden and C.D. Kolstad, eds., *Measuring the Demand for Environmental Quality*. Amsterdam: Elsevier Science Publishers B.V. pp. 227-270.

Caulkins, P.P., R.C. Bishop, and N.W. Bouwes. 1985. Omitted cross-price variable biases in the linear travel cost model: Correcting common misperceptions. *Land Economics* **61**(2): 182-187.

Clawson, M. 1959. *Methods of Measuring the Demand For and Value of Outdoor Recreation. Reprint No.10.* Resources for the Future, Washington, DC.

Dillman, D.A. 1978. *Mail and Telephone Surveys - The Total Design Method.* New York: John Wiley & Sons. 325 p.

Don Chapman Consultants, Inc. 1993. Assessment of Injury to Fish Populations: Clark Fork River NPL Sites, Montana (Appendix G to Lipton *et al.*, 1993a). Prepared for the State of Montana, Natural Resource Damage Program. February.

Duffield, J. 1989. Economic Analysis of Fishery Management Policy on Rock Creek. Prepared for Montana Dept. of Fish, Wildlife and Parks, Helena, MT. July. 32 p.

Duffield, J. 1991. Baseline Recreation Value of the Upper Clark Fork River Basin. Prepared for Montana Dept. of Fish, Wildlife and Parks, Helena, MT. June. 35 p.

Duffield, J. 1992. Survey Agent Training Manual: 1992 Southwestern Montana Angler Study. Prepared by Bioeconomics, Inc., Missoula, MT.

Duffield, J., J. Loomis, and R. Brooks. 1987. The Net Economic Value of Fishing in Montana. Published by Montana Dept. of Fish, Wildlife and Parks, Helena, MT. August. 85 p.

Duffield, J., S. Allen, and J. Holliman. 1988. Angler Preference Study, Final Economics Report: Contingent Valuation of Montana Trout Fishing by River and Angler Subgroup. Prepared for Montana Dept. of Fish, Wildlife and Parks, Helena, MT. September.

Duffield, J., D. Robson, C. Jones, and C. Neher. 1992a. 1992 Southwestern Montana Angler Study - Complete Day and Route Schedules Document. Prepared by Bioeconomics, Inc. June.

Duffield, J., D. Robson, C. Jones, and C. Neher. 1992b. 1992 Southwestern Montana Angler Study - Data Collection Protocols and Sampling Design. Prepared by Bioeconomics, Inc. June.

Frost, J.E. and S.F. McCool. 1986. The Montana Outdoor Recreation Needs Survey. Prepared by University of Montana School of Forestry for Montana Dept. of Fish, Wildlife and Parks, Helena, MT. January.

Hagmann, C. 1979. Recreational Use of the Upper Clark Fork River and its Tributaries. Wilderness Institute, Montana Forest and Conservation Experiment Station, University of Montana, Missoula, MT. 92 p.

Hanemann, W.M. and R.T. Carson. 1987. Southcentral Alaska Sport Fishing Economic Study. Prepared by Jones and Stokes Associates, Inc. for the Alaska Department of Fish and Game.

Hanemann, W.M. and E. Morey. 1992. Separability, partial demand systems and consumer's surplus measures. *Journal of Environmental and Economic Management* 22(3): 241-258.

Lipton, J., H. Bergman, D. Chapman, T. Hillman, M. Kerr, J. Moore, and D. Woodward. 1993a. Aquatic Resources Injury Assessment Report, Upper Clark Fork River Basin. Prepared by RCG/Hagler Bailly for the State of Montana, Natural Resource Damage Program. June.

Lipton, J., H. Galbraith, K. LeJeune, H. Bergman, and L. Kapustka. 1993b. Terrestrial Resources Injury Assessment Report, Upper Clark Fork River Basin. Prepared by RCG/Hagler Bailly for the State of Montana, Natural Resource Damage Program. September.

McFarland, R.C. 1989. Montana Statewide Angling Pressure Mail Survey 1982-1985. Prepared by Montana Dept. of Fish, Wildlife and Parks. April.

McFarland, R.C. 1992. Montana Statewide Angling Pressure Mail Survey 1989. Prepared by Montana Dept. of Fish, Wildlife and Parks. March.

McFarland, R.C. 1993. Personal Communication. Montana Department of Fish, Wildlife and Parks. July.

McFarland, R.C. and R. Brooks. 1993. Montana General Fishery Survey - Statewide Population Study (Forthcoming).

Morey, E.R., W.D. Shaw, and R.D. Rowe. 1991. A discrete-choice model of recreational participation, site choice, and activity valuation when complete trip data are not available. *J. of Environ. Econ. and Manage.* **20**:181-201.

Morey, E.R., R.D. Rowe, and M. Watson. 1993. A repeated nested-logit model of Atlantic salmon fishing. *Amer. J. of Agr. Econ.* **75**(August 1993): 578-592.

Office of Management and Budget. 1992. Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. Transmittal Memorandum No. 64 from Richard Darman, Director, Executive Office of the President, Office of Management and Budget, Washington, DC. October.

Parsons, G.R. and M.J. Kealy. 1992. Randomly drawn opportunity sets in a random utility model of lake recreation. *Land Economics* **68**(1): 93-106.

U.S. Bureau of the Census. 1987. *Statistical Abstract of the United States: 1987 (107th edition)*. U.S. Department of Commerce, Washington, DC. 960 p.

U.S. DOI. 1989. 1985 National Survey of Fishing, Hunting and Wildlife-Associated Recreation: Montana. Prepared by U.S. Fish Wildl. Serv., Washington, DC. March. 81 p.

U.S. DOI. 1991. Water Resources Data - Montana Water Year 1991. Prepared by R.R. Shields, J.R. Knapton, M.K. White, T.M. Brosten, and C.L. Chambers, U.S. Geological Survey in cooperation with the State of Montana and with other agencies. Water-Data Report MT-91-1. 528 p.

SOUTHWESTERN MONTANA 1992 SPECIAL USE FISHING INTERCEPT STUDY

SET-UP

INTERVIEWER CODE _____ RIVER CODE _____ ID# _____ TIME _____
MONTH/DAY ____/____
DAY TYPE 1 WEEKDAY 2 WEEKEND RAIN/BAD WEATHER? 1 NO 2 YES
TIME BLOCK 1 7:30-2:30 2 11:00-6:00 3 2:30-9:30

AGE GROUP 1 SENIOR 2 ADULT 3 JUVENILE
GENDER 1 MALE 2 FEMALE
FLOAT TRIP? 1 NO 2 YES FLY ROD? 1 NO 2 YES
TRIP WAS 1 COMPLETE 2 INCOMPLETE 3 ANGLER JUST ARRIVING

Q1 Hello, my name is _____. I'm conducting a fishing use survey on this river for the Montana Department of Fish, Wildlife and Parks. It would help us in the management of this river if I could ask you a few questions about your fishing today. May we have your help?

1 NO ➢ We hope you enjoy your fishing trip. ➢ ➢ END OF INTERVIEW
2 YES ➢ Thank you. Are you just starting to fish today? YES ➢
NO ➢ CONTINUE

Q1A If Float Trip, at what location did you put in your boat? _____ (nearest landmark)

2 Are you a full-time or part-time resident of Montana, or a non-resident?

1 FULL-TIME RESIDENT ➢ County of Residence ➢ _____
2 PART-TIME RESIDENT (owns or rents in Mont.) ➢ Nearest City/Town ➢ _____
3 NON-RESIDENT

State of Residence (If Part-time or Non-resident) _____
Is the primary purpose of having a Montana Residence to (Circle all that apply):
1 FISH OR HUNT 2 WORK, or 3 OTHER REASONS

THIS TRIP: I would like to ask you some questions about your trip here to the _____ river, focusing on this section between _____ and _____.

Q3 Sometimes people combine fishing trips with other activities. Was fishing the primary purpose of this trip? (A "trip" is any time you leave home or your part-time residence.) 1 NO 2 YES

Q4 What time did you actually start fishing on this segment of the _____ river today? _____ START

Q5 How many trout have you personally caught (including caught and released) so far today on this segment of the _____ river? _____ #TROUT

Q6 Of the _____ trout you caught, how many were greater than 16" long? _____ #>16"

Q7 Did you catch any fish other than trout on this segment of the river? 1 NO 2 YES
(IF YES, How many?) _____ #OTHER

Q8 How many more hours do you think you will fish today on this segment of the river? _____ HOURS

Q9 In total, how much time will you spend fishing on this segment of this river on this trip? _____ HOURS

Q10 In total, approximately how much money did you *personally* spent on this fishing trip for tackle and equipment and any guide or outfitters? (do not include food or gas for auto) _____ $EQUIP

Q11 How many nights do you expect to be away from home on this trip? _____ NIGHTS
IF > 0 nights ➢ How much, if anything, did you spend or do you expect to spend in total for lodging for these _____ nights away from home? _____ $LODGING

Q12 Did you visit other segments of this river, or other rivers or streams on this trip? 1 NO 2 YES
IF YES ➢ What other rivers or streams did you fish on this trip?

	Site(s)-river name and nearest landmark	Region Code	River Code
1.			
2.			
3.			

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

July

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 4 Logsheet

Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area, Butte Area, Bozeman Area, Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER JULY 24TH					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER AUGUST 21ST					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

July

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 5 Logsheet					
Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER AUGUST 14TH					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 6 Logsheet					
Trip (anytime you leave home to go fishing)	**Month in which trip took place**	**Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area**	**Did you fish at more than one river or stream on this trip? Yes or No**	**Name of river where you primarily fished and the name of the nearest town or landmark**	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER AUGUST 28TH					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 7 Logsheet					
Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 8 Logsheet					
Trip (anytime you leave home to go fishing)	**Month in which trip took place**	**Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area**	**Did you fish at more than one river or stream on this trip? Yes or No**	**Name of river where you primarily fished and the name of the nearest town or landmark**	**Code # for your Primary Site (if it is one of the sites on the map)**
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

APPENDIX 2B

TELEPHONE FOLLOW-UP SURVEY INSTRUMENTS

Telephone Questionnaire
Telephone Survey Response Rates by Wave

Montana Southwestern Rivers Fishing Study Telephone Questionnaire

Q1 Survey Agent number _____

Q2a Date of Last Contact by Intercept _____ Q2b Date of Last Contact by Phone _____

Q3 Current Date _____

Q4 Respondent ID number: _____

Dial the Telephone Number. If young child answers, ask for an adult.

Q5 Hello. I would like to speak with _____ , is s/he at this residence? 1 Yes 2 No

If No, then read: the number I was calling is _____ and it was for _____ (respondents first and last name) If number is not the respondent's phone number, thank them and end the interview. Note on call record - wrong number.

If Yes, wait for person to come to the phone and...

Q6 My name is _____ and I am calling on behalf of the Montana Department of Fish, Wildlife, and Parks. You were interviewed on (date) on the (river or stream name) for the Southwestern Rivers Special Use Study in Montana. I'd like to ask you a few questions about your recent fishing trips. Is now a good time to ask you these questions?

1 Yes ---> Continue
2 No ---> When would be a more convenient time to call? _____

Q7 Did you receive the log sheet we sent you and is it handy?

1 Yes ----> Continue
2 No ---> If No, Skip to BRANCH II.

BRANCH I - LOGSHEET.

Wait for them to get the log sheet.

Q8 Please refer to your log sheet and map if you need to.

How many trips to Montana streams or rivers have you taken since. (fill in date last the time s/he was interviewed in person or by phone) _____ trips (A trip is any time you leave your home)

If 0 ----> skip to End

Q9 I'd like to ask you about three (adjust number if fewer than three in Q8) of your fishing trips. Let's begin with the first trip you have recorded on your log sheet.

Trip 1 (Your first trip on the log sheet)

Q10a In what month was that trip taken? _____

Q10b What region of Montana were you in during this trip? _____ (Region on logsheet)

Q10c Did you visit more than one river or stream during this trip?

1 Yes ----> The next questions pertain to the river on which you fished most of your time.
2 No

Q10d What was the name of this river or stream? _____

Q10e What was the name/nearest landmark of this river or stream? _____

Q10f Can you determine the River Code? Yes ----> _____ (Refer to Map and determine if one of our 28 sites. Code = 30 if not one of our sites, Code = 99 if cannot be determined)

Trip 2 (Second log sheet trip - skip if they did not take more than one trip)

Q11a In what month did you take that trip? _____

Q11b What region of Montana were you in during this trip? _____ (Region on logsheet)

Q11c Did you visit more than one river or stream during this trip?

1 Yes ----> The next questions pertain to the river on which you predominantly fished.
2 No

Q11d What was the name of this river or stream? _____

Q11e What was the name/nearest landmark of this river or stream? _____

Q11f Can you determine the River Code? Yes ----> _____ (Refer to Map and determine if one of our 28 sites. Code = 30 if not one of our sites, Code = 99 if cannot be determined)

Trip 3 (Third log sheet trip - skip if they did not take more than two trips)

Q12a In what month did you take that trip? _____

Q12b What region of Montana were you in during this trip? _____ (Region on logsheet)

Q12c Did you visit more than one river or stream during this trip?

1 Yes ----> The next questions pertain to the river on which you predominantly fished.
2 No

Q12d What was the name of this river or stream? _____

Q12e What was the name/nearest landmark of this river or stream? _____

Q12f Can you determine the River Code? Yes ---> _____ (Refer to Map and determine if one of our 28 sites. Code = 30 if not one of our sites, Code = 99 if cannot be determined)

BRANCH II - NO LOGSHEET.

Record information here only if the respondent does not have his or her logsheet.

Q13 How many trips to Montana streams or rivers have you taken since (fill in date last the time s/he was interviewed in person or by phone) _____ trips (A trip is any time you leave your home)

If 0 ---> skip to End

I'd like to ask you about three (adjust number if fewer than three in Q13) of your most recent fishing trips. Let's begin with the last trip you took since we interviewed you by (enter phone or intercept).

Trip 1 (Your most recent trip)

Q14a In what month was that trip taken? _____

Q14b What region of Montana were you in during this trip? _____ (Ask them nearest town or landmark)

Q14c Did you visit more than one river or stream during this trip?

1 Yes ----> The next questions pertain to the river on which you predominantly fished.
2 No

Q10d What was the name of this river or stream? _____ Nearest Landmark? _____

(Interviewer: Refer to Map and determine if one of our 28 sites)

Q10e River Code _____ (Record "30" if not one of our sites, "99" if cannot be determined.)

Trip 2 (Your next most recent trip since you were interviewed)

Q15a In what month was that trip taken? _____

Q15b What region of Montana were you in during this trip? _____ (Ask them nearest town or landmark)

Q15c Did you visit more than one river or stream during this trip?

1 Yes ----> The next questions pertain to the river on which you predominantly fished.

2 No

Q15d What was the name of this river or stream? _____ Nearest Landmark? _____

(Interviewer: Refer to Map and determine if one of our 28 sites)

Q15e River Code _____ (Record "30" if not one of our sites, "99" if cannot be determined)

Trip 3 (Your third most recent trip since you were interviewed)

Q15a In what month was that trip taken? _____

Q15b What region of Montana were you in during this trip? _____ (Ask them nearest town or landmark)

Q15c Did you visit more than one river or stream during this trip?

1 Yes ---> The next questions pertain to the river on which you predominantly fished.
2 No

Q15d What was the name of this river or stream? _____ Nearest Landmark? _____

(Interviewer: Refer to Map and determine if one of our 28 sites)

Q15e River Code _____ (Record "30" if not one of our sites, "99" if cannot be determined)

Thank you for your cooperation with this phone survey. Please recall that we will be contacting you again by phone during the week of _(enter date for next call)_ and in early September by mail.

Q16 Would you like us to send you another logsheet? 1 YES 2 NO

Q17 Do you have any questions or comments at this time?

_____

_____

_____

WESTERN MONTANA FISHING SURVEY
RESPONSE RATE
SPRING 1992 – Phase 1

Wave 1A:	**Total in List**	=106
	Total Number of No Listings	= 11
	Total Number of Completes	= 92
	Total Number of Called but Not Reached	= 3
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 87%
Wave 2A:	**Total in List**	=111
	Total Number of No Listings	= 5
	Total Number of Completes	= 97
	Total Number of Called but Not Reached	= 6
	Duplicates	= 3
	Total Response Rate (Completes/Eligibles)	= 87%
Wave 3A:		
	Total in List	=111
	Total Number of No Listings	= 9
	Total Number of Completes	= 92
	Total Number of Called but Not Reached	= 10
	Duplicates	= 1
	Total Response Rate (Completes/Eligibles)	= 82%
Wave 4A:	**Total in List**	=107
	Total Number of No Listings	= 5
	Total Number of Completes	= 95
	Total Number of Called but Not Reached	= 7
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 88%
Wave 5A:	**Total in List**	=108
	Total Number of No Listings	= 1
	Total Number of Completes	= 98
	Total Number of Called but Not Reached	= 9
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 90%
Wave 6A:	**Total in List**	= 98
	Total Number of No Listings	= 4
	Total Number of Completes	= 83
	Total Number of Called but Not Reached	= 11
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 85%

Eligibles–Persons qualified to take part in the survey.

Called but not reached–calls were made, but answers were not obtained due to one of the following: answering machine, no answer, busy signal, disconnect, incorrect number listing, duplicate call, refusal, deafness or language impairment, ineligible party, or other.

Social Survey Research Unit
College of Agriculture
University of Idaho

FISHING IN SOUTHWESTERN MONTANA: FINAL 1992 ANGLER SURVEY

Please return survey to:
Montana Department of Fish, Wildlife, and Parks
Fisheries Division
1420 E. Sixth Ave.
Helena, MT 59620

Version 1

INTRODUCTION

Thank you for participating in this summer's Southwestern Montana River Study. We are asking you to help us one last time. The answers you give will be used to help better manage fishing in Southwestern Montana. For these questions, Southwestern Montana refers to the area on the map enclosed with this survey.

Q1 Overall, how do you rate the quality of fishing in Southwestern Montana? **(Circle number of best response.)**

VERY POOR ▼ 1 — 2 — 3 — 4 — 5 — 6 — 7 ▼ EXCELLENT

DON'T KNOW ▼ 8

Q2 Please provide any suggestions you have to improve fishing in Southwestern Montana.

_____

_____

_____

Q3 When you choose among fishing sites in Southwestern Montana, generally how important is each of the following when making your choice of a particular site? (Circle number of best response for each).

	NOT AT ALL IMPORTANT ▼						VERY IMPORTANT ▼
THE SPECIES OF FISH YOU CAN CATCH	1	2	3	4	5	6	7
THE NUMBER OF FISH YOU THINK YOU WILL CATCH	1	2	3	4	5	6	7
THE SIZE OF THE LARGEST FISH YOU HOPE TO CATCH	1	2	3	4	5	6	7
TO BE ABLE TO FISH IN CATCH & RELEASE WATERS	1	2	3	4	5	6	7
TO BE ABLE TO FISH CLOSE TO YOUR HOME	1	2	3	4	5	6	7
TO BE ABLE TO FISH AT A VERY SCENIC SITE	1	2	3	4	5	6	7
TO AVOID FISHING AT AN UNATTRACTIVE SITE	1	2	3	4	5	6	7
TO FISH AT MANY DIFFERENT SITES	1	2	3	4	5	6	7
TO VISIT SITES THAT ARE ATTRACTIVE IN TERMS OF THE QUALITY OF THE SITE FOR NON-FISHING RECREATION	1	2	3	4	5	6	7

4 From unfamiliar (never fished, read about or heard about) to very familiar (often fished, read about or heard about), how familiar are you with each of the following fishing sites? (Circle number of best response for each site.)

	UNFAMILIAR						VERY FAMILIAR
	▼						▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7
ROCK-CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7

Questions 5 through 7 ask for your rating of various characteristics of these four fishing sites. Please rate these sites in comparison to other Southwestern Montana rivers and streams.

5 How would you rate each of the sites below in terms of the <u>largest fish you would expect to catch</u> at the site? (Circle number of best response for each site.)

	BELOW AVERAGE					ABOVE AVERAGE		DON'T KNOW
	▼						▼	▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q6 How would you rate each of the sites below in terms of the number of fish you would expect to catch in a typical four hours of fishing? (Circle number of the best response for each site.)

	BELOW AVERAGE ▼						ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q7 How would you rate each of the sites below in terms of the quality of non-fishing recreation activities (hiking, birdwatching, etc.) at the site? (Circle number of the best response for each site.)

	BELOW AVERAGE ▼						ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q8 Please provide any comments you have on your rankings of the sites in Question 5 through 7 above, especially for the sites you rate as below average.

ABOUT YOUR RECENT TRIPS

9 Since we last contacted you on _____, how many trips to all Montana streams or rivers have you taken?

_____ TRIPS----------> IF ZERO, PLEASE SKIP TO TOP, PAGE 6

10 We would like some information on three of your recent trips since we last contacted you.

> If you have used the logsheet we sent to you, please copy the information since our last contact into the table below.

> If you have not kept the log, please complete the table below for the last three trips you have taken to all Montana rivers or streams since we last contacted you.

> Even if you have taken fewer than three trips to Montana sites since we last contacted you, please fill in the table for your trips to Montana sites since we last contacted you.

INFORMATION ON THREE OF YOUR RECENT FISHING TRIPS

(See Instructions Above)

	TRIP ONE	TRIP TWO	TRIP THREE
MONTH TRIP TAKEN			
REGION(S) VISITED (ENTER MISSOULA, HELENA, BUTTE, BOZEMAN OR "OTHER")			
DID YOU FISH AT MORE THAN ONE RIVER OR STREAM? (YES/NO)			
NAME OF PRIMARY SITE VISITED/NEAREST LANDMARK (ALSO ENTER CODE NUMBER FROM INSERTED MAP IF APPLICABLE)			
NUMBER OF FAMILY MEMBERS IN YOUR PARTY			
NUMBER OF NON-FAMILY MEMBERS IN YOUR PARTY			

Q11 Answer the following for your trip recorded in column one of the table on page four.

a. How many nights were you away from home? . . . . . _____ NIGHTS

b. During this trip did you work on any of the days you fished? (For example, did you fish before or after work?)

1 NO

2 YES ——> ON HOW MANY DAYS DID YOU WORK? ___ DAYS

Continuing with your trip in column one above, if you visited *more than one* site, please answer the following questions just for the primary site you visited (the site where you spent the most time).

c. How many total hours did you spend at the site (fishing and non-fishing)? . . . . . _____ HOURS

d. How many hours did you spend actively fishing? . . . . . _____ HOURS

e. What was the total number of trout you personally caught? . . _____ TROUT

f. How many fish of other species did you personally catch? . . . _____ FISH

g. What types of fish were you trying to catch? (Circle number of best answer.)

1 NO PREFERENCE
2 ANY TYPE OF TROUT
3 RAINBOW TROUT
4 BROWN TROUT
5 OTHER TROUT (PLEASE SPECIFY) _____
6 WHITE FISH
7 OTHER (PLEASE SPECIFY) _____

h. Were any other members of your party primarily involved in non-fishing recreation at this site?

1 NO
2 YES ——> NUMBER OF PEOPLE PRIMARILY INVOLVED IN NON-FISHING RECREATION _____ WHAT ACTIVITIES _____ _____

HOW WOULD CHANGES IN FISHING QUALITY AFFECT YOUR FISHING TRIPS?

The next questions concern changing catch rates at two of the sites you rated in Questions 4 - 7. For these questions, assume catch rates change only at the river being discussed. Conditions on all other Montana rivers remain unchanged.

Q12 First consider the Clark Fork River between Garrison Junction and Rock Creek (sites 2 and 3 on your map). Approximately how many fishing trips did you take to this site between May 1st and September 6th of 1992?

_____ TRIPS

Q13 In Q6 you rated your expected catch at this Clark Fork Site. Suppose that a change in management programs at this site increased the number of trout you would expect to catch in a typical 4 hours of fishing.

If you would expect to catch _____ more trout (than you now expect to catch) each 4 hours how would you rate the number of fish you expect to catch at this Clark Fork site as compared to other Southwestern Montana sites? (Circle number of best response.)

BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q14 If average catch at this Clark Fork site increased as in Q13, approximately how many more trips in 1992, if any, do you feel you would have taken to this Clark Fork River site? (Enter your best estimate below or write "Don't know".)

_____ ADDITIONAL TRIPS

Q15 If catch increased at this Clark Fork River site, would you still have taken the same number of trips in 1992 to other sites, or would you have fished less at other sites? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——————> HOW MANY FEWER TRIPS?____ TRIPS

3 MORE TRIPS TO OTHER SITES ——————> HOW MANY MORE TRIPS?____ TRIPS

8 DON'T KNOW

Q26 How many hours in a typical weekday do you spend in the following activities?

_____HOURS PER DAY SPENT WORKING FOR WAGES OR SALARY

_____HOURS PER DAY SPENT IN HOUSEHOLD CHORES OR CHILDCARE

_____HOURS PER DAY SPENT SLEEPING

_____HOURS PER DAY SPENT IN SCHOOL OR DOING SCHOOL WORK

Q27 How many days do you work in a typical working week?

____ DAYS FULL-TIME

____ DAYS PART-TIME

Q28 If you are employed outside of the home, approximately how many weeks of paid vacation (including holidays) per year do you have?

1 NONE
2 ONE
3 TWO
4 THREE
5 FOUR OR MORE
6 NOT APPLICABLE

Q29 What was your total household income in 1991 before taxes and deductions? Please include all income to this household including social security, interest, dividends from investments, welfare payments, child support, etc. (Circle one number.)

1	UNDER $10,000	6	$40,000 - $49,999	11	$100,000 - $124,999
2	$10,000 - $14,999	7	$50,000 - $59,999	12	$125,000 - $149,999
3	$15,000 - $19,999	8	$60,000 - $69,999	13	$150,000 - $200,000
4	$20,000 - $29,999	9	$70,000 - $79,999	14	MORE THAN $200,000
5	$30,000 - $39,999	10	$80,000 - $99,999	15	CHOOSE NOT TO ANSWER

Q30 If employed outside of the home, please categorize your approximate hourly wage rate.

1	UNDER $5 PER HOUR	5	$15 - $19.99	9	$40 - $49.99
2	$5 - 8.00	6	$20 - $24.99	10	MORE THAN $50 PER HOUR
3	$8 - $11.99	7	$25 - $29.99	11	DOES NOT APPLY
4	$12 - $14.99	8	$30 - $39.99	12	CHOOSE NOT TO ANSWER

1 If you worked four more hours per week than you normally do (by taking a second job or working more hours at your principal job), approximately what hourly wage would you expect to earn for each of those four hours?

$ _____ /HOUR

IF YOU ARE A RESIDENT, PLEASE SKIP TO THE BACK PAGE.

ANSWER THE FOLLOWING QUESTIONS ONLY IF YOU ARE NOT A RESIDENT OF MONTANA.

2 When you last fished in Montana did you travel to Montana by: (Circle number of best response)

1 AUTOMOBILE
2 AIRPLANE
3 OTHER

What was the approximate round trip airfare from your home to your destination point in Montana?

_____$ AIRFARE

FROM (ENTER ORIGIN CITY) _____

TO (ENTER DESTINATION CITY) _____

What were your expenses for a rental car, if one was used in Montana?

_____$ FOR RENTAL CAR

34 Was the primary purpose of this trip to fish in Montana (as opposed to other recreation, work, or for other purposes)?

1 YES
2 NO ——> If No, from which city or town in Montana did your Montana fishing trip start?

ENTER CITY OR TOWN IN MONTANA _____

Please use this space for any comments you might have for the Montana Department of Fish, Wildlife and Parks.

Thank you very much for all of your help this season! We wish you great fishing next year.

FISHING IN SOUTHWESTERN MONTANA: FINAL 1992 ANGLER SURVEY

Please return survey to:
Montana Department of Fish, Wildlife, and Parks
Fisheries Division
1420 E. Sixth Ave.
Helena, MT 59620

Version 2

INTRODUCTION

Thank you for participating in this summer's Southwestern Montana River Study. We are asking you to help us one last time. The answers you give will be used to help better manage fishing in Southwestern Montana. For these questions, Southwestern Montana refers to the area on the map enclosed with this survey.

Q1 Overall, how do you rate the quality of fishing in Southwestern Montana? (**Circle number of best response.**)

VERY POOR						EXCELLENT	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q2 Please provide any suggestions you have to improve fishing in Southwestern Montana.

_____

_____

_____

Q3 When you choose among fishing sites in Southwestern Montana, generally how important is each of the following when making your choice of a particular site? (Circle number of best response for each).

	NOT AT ALL IMPORTANT ▼						VERY IMPORTANT ▼
THE SPECIES OF FISH YOU CAN CATCH	1	2	3	4	5	6	7
THE NUMBER OF FISH YOU THINK YOU WILL CATCH	1	2	3	4	5	6	7
THE SIZE OF THE LARGEST FISH YOU HOPE TO CATCH	1	2	3	4	5	6	7
TO BE ABLE TO FISH IN CATCH & RELEASE WATERS	1	2	3	4	5	6	7
TO BE ABLE TO FISH CLOSE TO YOUR HOME	1	2	3	4	5	6	7
TO BE ABLE TO FISH AT A VERY SCENIC SITE	1	2	3	4	5	6	7
TO AVOID FISHING AT AN UNATTRACTIVE SITE	1	2	3	4	5	6	7
TO FISH AT MANY DIFFERENT SITES	1	2	3	4	5	6	7
TO VISIT SITES THAT ARE ATTRACTIVE IN TERMS OF THE QUALITY OF THE SITE FOR NON-FISHING RECREATION	1	2	3	4	5	6	7

From unfamiliar (never fished, read about or heard about) to very familiar (often fished, read about or heard about), how familiar are you with each of the following fishing sites? (Circle number of best response for each site.)

	UNFAMILIAR						VERY FAMILIAR
	▼						▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7
THE MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7

uestions 5 through 7 ask for your rating of various characteristics of these four fishing sites. ease rate these sites in comparison to other Southwestern Montana rivers and streams.

5 How would you rate each of the sites below in terms of the <u>largest fish you would expect to catch</u> at the site? (Circle number of best response for each site.)

	BELOW AVERAGE					ABOVE AVERAGE		DON'T KNOW
	▼					▼		▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q6 How would you rate each of the sites below in terms of the number of fish you would expect to catch in a typical four hours of fishing? (Circle number of the best response for each site.)

	BELOW AVERAGE ▼						ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q7 How would you rate each of the sites below in terms of the quality of non-fishing recreation activities (hiking, birdwatching, etc.) at the site? (Circle number of the best response for each site.)

	BELOW AVERAGE ▼						ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q8 Please provide any comments you have on your rankings of the sites in Question 5 through 7 above, especially for the sites you rate as below average.

ABOUT YOUR RECENT TRIPS

Q9 Since we last contacted you on _____, how many trips to all Montana streams or rivers have you taken?

_____ TRIPS ——————> IF ZERO, PLEASE SKIP TO TOP, PAGE 6

Q10 We would like some information on three of your recent trips since we last contacted you.

> If you have used the logsheet we sent to you, please copy the information since our last contact into the table below.

> If you have not kept the log, please complete the table below for the last three trips you have taken to all Montana rivers or streams since we last contacted you.

> Even if you have taken fewer than three trips to Montana sites since we last contacted you, please fill in the table for your trips to Montana sites since we last contacted you.

INFORMATION ON THREE OF YOUR RECENT FISHING TRIPS

(See Instructions Above)

	TRIP ONE	TRIP TWO	TRIP THREE
MONTH TRIP TAKEN			
REGION(S) VISITED (ENTER MISSOULA, HELENA, BUTTE, BOZEMAN OR "OTHER")			
DID YOU FISH AT MORE THAN ONE RIVER OR STREAM? (YES/NO)			
NAME OF PRIMARY SITE VISITED/NEAREST LANDMARK (ALSO ENTER CODE NUMBER FROM INSERTED MAP IF APPLICABLE)			
NUMBER OF FAMILY MEMBERS IN YOUR PARTY			
NUMBER OF NON-FAMILY MEMBERS IN YOUR PARTY			

Q11 Answer the following for your trip recorded in column one of the table on page four.

a. How many nights were you away from home? . . . . . _____ NIGHTS

b. During this trip did you work on any of the days you fished? (For example, did you fish before or after work?)

1 NO

2 YES ——> HOW MANY DAYS DID YOU WORK? ___ DAYS

Continuing with your trip in column one above, if you visited *more than one* site, please answer the following questions just for the primary site you visited (the site where you spent the most time).

c. How many total hours did you spend at the site (fishing and non-fishing)? . . . . . _____ HOURS

d. How many hours did you spend actively fishing? . . . . . _____ HOURS

e. What was the total number of trout you personally caught? . . _____ TROUT

f. How many fish of other species did you personally catch? . . . _____ FISH

g. What types of fish were you trying to catch? (Circle number of best answer.)

1 NO PREFERENCE
2 ANY TYPE OF TROUT
3 RAINBOW TROUT
4 BROWN TROUT
5 OTHER TROUT (PLEASE SPECIFY) _____
6 WHITE FISH
7 OTHER (PLEASE SPECIFY) _____

h. Were any other members of your party primarily involved in non-fishing recreation at this site?

1 NO
2 YES ——> NUMBER OF PEOPLE PRIMARILY INVOLVED IN NON-FISHING RECREATION _____ WHAT ACTIVITIES _____ _____

HOW WOULD CHANGES IN FISHING QUALITY AFFECT YOUR FISHING TRIPS?

he next questions concern changing catch rates at two of the sites you rated in Questions 4 - 7. For these questions, assume catch rates change only at the river being discussed. onditions on all other Montana rivers remain unchanged.

Q12 First consider the Clark Fork River between Perkins Lane and Garrison Junction (site 12 on your map). Approximately how many fishing trips did you take to this site between May 1st and September 6th of 1992?

_____ TRIPS

Q13 In Q6 you rated your expected catch at this Clark Fork site. Suppose that a change in management programs at this Clark Fork site increased the number of trout you would expect to catch in a typical 4 hours of fishing.

If you would expect to catch _____ more trout (than you now expect to catch) each 4 hours how would you rate the number of fish you expect to catch at this Clark Fork site as compared to other Southwestern Montana sites? (Circle number of best response.)

BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q14 If average catch at this Clark Fork site increased as in Q13, approximately how many more trips in 1992, if any, do you feel you would have taken to this Clark Fork River site? (Enter your best estimate below or write "Don't know".)

_____ ADDITIONAL TRIPS

Q15 If catch increased at this Clark Fork River site, would you still have taken the same number of trips in 1992 to other sites, or would you have fished less at other sites? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——————> HOW MANY FEWER TRIPS?____ TRIPS

3 MORE TRIPS TO OTHER SITES ——————> HOW MANY MORE TRIPS?____ TRIPS

8 DON'T KNOW

Q16 Please provide any comments that help explain your answers to questions 13 - 15.

_____

_____

Q17 Now consider the Madison River from Lyons to Varney (site 27 on your map). Approximately how many fishing trips did you take to this stretch of the Madison River between May 1st and September 6th?

_____ TRIPS

Q18 In Q6 you rated your expected catch at this Madison River site. Suppose that management programs at this Madison River site changed the number of trout so that you would expect to catch _____ trout than you now expect to catch in a typical 4 hours of fishing.

With this new catch rate, how would you rate the number of fish you expect to catch in a typical four hours of fishing at this Madison River site as compared to other Southwestern Montana sites?

BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q19 If such a change in catch rates had occurred at this Madison River site, approximately how many more or fewer trips, if any, do you feel you would have taken to this Madison River site this season? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO THE MADISON RIVER

2 FEWER TRIPS TO THE MADISON RIVER ——> HOW MANY FEWER TRIPS? ____ TRIPS

3 MORE TRIPS TO THE MADISON RIVER ——> HOW MANY MORE TRIPS? ____ TRIPS

8 DON'T KNOW

Q20 Would you still have taken the same number of trips to other sites, or would you have fished more or less at other sites this season? (Circle number for best answer below)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——> HOW MANY FEWER TRIPS? ____ TRIPS

3 MORE TRIPS TO OTHER SITES ——> HOW MANY MORE TRIPS? ____ TRIPS

8 DON'T KNOW

Q21 Please provide any comments that help explain your answers to questions 18 - 20.

_____

_____

_____

ABOUT YOU AND YOUR HOUSEHOLD

Your answers to these questions will help us group your response with those of other anglers.

Q22 Including 1992, about how many years have you fished in Montana? (Circle number of best answer).

_____ YEARS

Q23 Overall, how would you rate your fishing skills? (Circle best number).

NOVICE						EXPERT
▼						▼
1	2	3	4	5	6	7

Q24 How many people in your household are in the following age groups? (Enter number or zero for each age group).

_____ UNDER 5 YEARS OF AGE
_____ BETWEEN 5 AND 16
_____ BETWEEN 17 AND 20
_____ BETWEEN 21 AND 65
_____ OVER 65 YEARS OLD

Q25 What is the highest level of schooling you completed? (Circle number of best answer.)

1 SOME HIGH SCHOOL OR LESS
2 HIGH SCHOOL GRADUATE
3 SOME COLLEGE, TRADE OR VOCATIONAL SCHOOL
4 TRADE OR VOCATIONAL SCHOOL GRADUATE
5 COLLEGE GRADUATE
6 SOME GRADUATE SCHOOL
7 ADVANCED DEGREE

Q26 How many hours in a typical weekday do you spend in the following activities?

_____HOURS PER DAY SPENT WORKING FOR WAGES OR SALARY

_____HOURS PER DAY SPENT IN HOUSEHOLD CHORES OR CHILDCARE

_____HOURS PER DAY SPENT SLEEPING

_____HOURS PER DAY SPENT IN SCHOOL OR DOING SCHOOL WORK

Q27 How many days do you work in a typical working week?

____ DAYS FULL-TIME

____ DAYS PART-TIME

Q28 If you are employed outside of the home, approximately how many weeks of paid vacation (including holidays) per year do you have?

1 NONE
2 ONE
3 TWO
4 THREE
5 FOUR OR MORE
6 NOT APPLICABLE

Q29 What was your total household income in 1991 before taxes and deductions? Please include all income to this household including social security, interest, dividends from investments, welfare payments, child support, etc. (Circle one number.)

1	UNDER $10,000	6	$40,000 - $49,999	11	$100,000 - $124,999
2	$10,000 - $14,999	7	$50,000 - $59,999	12	$125,000 - $149,999
3	$15,000 - $19,999	8	$60,000 - $69,999	13	$150,000 - $200,000
4	$20,000 - $29,999	9	$70,000 - $79,999	14	MORE THAN $200,000
5	$30,000 - $39,999	10	$80,000 - $99,999	15	CHOOSE NOT TO ANSWER

Q30 If employed outside of the home, please categorize your approximate hourly wage rate.

1	UNDER $5 PER HOUR	5	$15 - $19.99	9	$40 - $49.99
2	$5 - 8.00	6	$20 - $24.99	10	MORE THAN $50 PER HOUR
3	$8 - $11.99	7	$25 - $29.99	11	DOES NOT APPLY
4	$12 - $14.99	8	$30 - $39.99	12	CHOOSE NOT TO ANSWER

Q31 If you worked four more hours per week than you normally do (by taking a second job or working more hours at your principal job), approximately what hourly wage would you expect to earn for each of those four hours?

$ _____ /HOUR

IF YOU ARE A RESIDENT, PLEASE SKIP TO THE BACK PAGE.

ANSWER THE FOLLOWING QUESTIONS ONLY IF YOU ARE NOT A RESIDENT OF MONTANA.

Q32 When you last fished in Montana did you travel to Montana by: (Circle number of best response)

1 AUTOMOBILE
2 AIRPLANE
3 OTHER

What was the approximate round trip airfare from your home to your destination point in Montana?

_____$ AIRFARE

FROM (ENTER ORIGIN CITY) _____

TO (ENTER DESTINATION CITY) _____

What were your expenses for a rental car, if one was used in Montana?

_____$ FOR RENTAL CAR

Q34 Was the primary purpose of this trip to fish in Montana (as opposed to other recreation, work, or for other purposes)?

1 YES
2 NO —>

If No, from which city or town in Montana did your Montana fishing trip start?

ENTER CITY OR TOWN IN MONTANA _____

Please use this space for any comments you might have for the Montana Department of Fish, Wildlife and Parks.

Thank you very much for all of your help this season! We wish you great fishing next year.

Montana Department of Fish, Wildlife & Parks

NAME
ADDRESS

September 11, 1992

Dear NAME:

Thank you for participating in this summer's Southwestern Montana River Study. To help the Montana Department of Fish, Wildlife and Parks to improve its understanding and management of Montana's fishery resources, we are asking for your help one last time.

This mail survey asks about your recent fishing activities and about your opinions about the management of fishing activity in Montana. To conserve our resources, you are part of a small group from whom we have collected data earlier this summer. Regardless of whether you fish often or will never fish in Montana again, it is important that we hear from you so that we accurately understand the needs of different anglers using Montana waters and so we can use the information you provided to us earlier this summer.

Your responses are strictly confidential, only general results will be reported, such as "the percent of license holders who fish more than 10 times in a season." The identification number on your questionnaire is there so we can check you name off the mailing list when it is returned, and to match this data with the information you previously provided. The Department of Fish, Wildlife and Parks appreciates your effort to help us do the best job managing Montana fisheries that is possible. As a thank you, we will send you a summary of our results when the study is completed.

Sincerely,

Howard E. Johnson
Chief, Fisheries Management Bureau

September 22, 1992

Recently, a questionnaire was mailed to you seeking information on your recent fishing trips in Montana. Your household is one of only a small number of people being asked to give this information.

If you have already completed and returned your questionnaire to us, please accept our sincere thanks. If not, we ask that you do so today. We are especially grateful for your help. Your responses will be used to help shape future management of the state's rivers and streams.

Sincerely,

Howard Johnson,
Chief, Fisheries Management Bureau

Montana Department of Fish, Wildlife & Parks

NAME
ADDRESS

October 9, 1992

Dear NAME:

Thank you for participating in the Southwestern Montana Rivers study this summer. Your participation will help us to better understand and manage Montana's valuable fishery resources for you and for other anglers like you.

As a final step in this study, three weeks ago I sent a questionnaire about your recent fishing activity and on your opinions about the management of Montana fisheries. As of today, we have not received your completed questionnaire.

I am writing to you again because your participation in this final survey is important to the success of this study. You are a member of a small group of anglers from whom we are collecting data for the entire 1992 fishing season. For the results to truly represent the fishing behavior and opinions of all Montana anglers, it is essential that we receive a completed questionnaire for each person in the sample. Even if you feel you will never again fish in Montana, your opinions will help us manage the resource for other users like you.

Some people have told us particular questions are hard to answer. Management decisions are also hard to make without your input. We are asking you to answer the best you can.

In the event that your questionnaire has been misplaced, a replacement is enclosed. Please return the questionnaire as soon as you can in the return envelope provided. Your assistance is greatly appreciated.

Sincerely,

Howard E. Johnson
Chief, Fisheries Management Bureau

MONTANA FINAL MAIL SURVEY PHONE FOLLOW-UP: PART I

Hello, my name is _____, and I'm working with the State of Montana's Department of Fish, Wildlife and Parks. I'm calling for _____. Is he/she at home? Could I speak with him/her?

IF NO -

Is there a more convenient time when I can call back to reach him/her?

Yes - TIME_____ DAY_____ Thank you. Goodbye.

No - We recently sent (respondent) a survey about fishing in Montana. We are calling to encourage him/her to complete and return it to us. This is the last part of a summer long study. We very much need to have (respondent) complete this last part so the data he/she provided early this summer can be used. Would it be possible for you to remind him/her about the survey?

YES
NO, REFUSE NO, BUSY DECEASED

Thank you. Goodbye.

IF YES-

A couple of weeks ago a survey was sent to you asking about your recent trips to Montana rivers. Did you receive it?

NO - Hearing from you is very important. Could we send you another survey?

NO - Try **. If still NO - Go to part II.
YES - I'll get it in the mail to you right away. Let me verify your address:_____

Thank you for your time. We look forward to hearing from you.

YES, IT HAS BEEN RETURNED - Thank you for your time. Goodbye.

** YES, NOT RETURNED - You are part of a small group of anglers from whom we have been collecting data throughout the 1992 fishing season. This survey is the very last step in the process. For our survey results to accurately represent the opinions of those who fish in Montana, it is important that we receive a completed survey from every person in this sample. Even if you think you will never fish again in Montana, your response is important to the completion of this study. Could I count on you to complete the survey and return it to us as soon as possible?

Yes - Thank you very much.

No - Go to part II.

CODENUM____ GENDER____ LANGUAGE BARRIER? 1 NONE 2 POSSIBLE 3 DEFINITE

PART II.

Q0 It is very important that we understand how those who did not return the survey compare to those who did so we don't misinterpret the results. Could I take just a few minutes of your time to ask you four questions?

1 NO - Thank you. I hope I have not inconvenienced you.
2 YES - Thank you.

Q1 How would you rate your fishing ability on a scale from one to seven with one representing a novice angler and seven an expert

NOVICE 1 2 3 4 5 6 7 EXPERT

Q2 Since we last contacted you on (date of last contact), have you taken any trips to any streams or rivers in Montana?

1 NO - Q3
2 YES - How many trips have you take since (date of last contact)?

_____ TRIPS

I'd like to ask you about your most recent trip:

What month was the trip:_____
What was your primary fishing site:_____ Region:_____
Did you fish at more than one river or stream on this trip:
1 NO
2 YES

Q3 We are asking this next question so that your responses can be categorized with others like yourself. I am going to read off six categories representing different annual household incomes before taxes and deductions. Could you please tell me into which category your household falls:

1 UNDER $10,000
2 $10,000-$40,000
3 $40,000-$60,000
4 $60,000-$100,000
5 $100,000-$200,000
6 GREATER THAN $200,000
7 CHOOSE NOT TO ANSWER

Q4 Please categorize your approximate hourly wage. Again I will read off categories:

1 UNDER $8 PER HOUR
2 BETWEEN $8 AND $15
3 BETWEEN $15 AND $20
4 BETWEEN $20 AND $30
5 BETWEEN $30 AND $40
6 OVER $40
7 DOES NOT APPLY
8 CHOOSE NOT TO ANSWER

Thank you for your time. Goodbye.

WHAT THE RESPONDENT MAY WANT TO KNOW ABOUT THE PHONE FOLLOW-UP SURVEY

Q: Who do you work for?
A: I am representing the Montana Department of Fish, Wildlife and Parks.

Q: Why are you doing this study?
A: To better understand fishing behavior throughout the season in the State of Montana, and ultimately to be able to better manage Montana rivers and streams.

Q: Why are you bothering me again with this survey?
A: We are eventually trying to improve fisheries management in Montana. To do so, we are trying to understand the attitudes and participation levels for a small sample of all different types of Montana anglers. Even if you have taken no fishing trips to Montana rivers and streams since you were last contacted, we need your help on this last piece of the study.

Q: Does this have anything to do with [the mining wastes/ARCO/CF environmental damage/other cases/other issues]?
A: The information from this survey will be available to the Department of Fish, Wildlife and Parks for all of its management activities.

Q: Why did you select me (our household)?
A: You were a member of the intercept group the we contacted this summer.

Q: Why all the information about my household? Why do you need to know income, etc.
A: I can assure you your responses are strictly confidential and are never tied to your name.

Q: They should do... They should not do... (The government, the state, etc.)
A: I will note that on the survey form to make sure it is included. All results will be made available to the Department of Fish, Wildlife and Parks for all of its management activities.

Q: Is this confidential?
A: Yes! Most definitely! All the information we release is in the terms of the percent of respondents that provided certain answers to particular questions. In this form, no individual can ever be identified. Moreover, the matter of confidentiality is terribly important to the success of our work as we do many surveys. Thus we are very careful to protect an individual's anonymity.

Q: Who is sponsoring this survey?
A: The Montana Department of Fish, Wildlife and Parks.

Q: How many people will be participating in the study?
A: You are a member of a group of approximately 1,000 anglers who fished at Montana rivers and streams during the 1992 season.

APPENDIX 3A

ADDITIONAL SURVEY RESULTS

Table 3A-1
Selected Statistics from Intercept Survey

Table 3A-2
Site Destinations of Intercept Trips

Table 3A-3
Summary of Trip Data from the Telephone Survey

Table 3A-4
Selected Statistics from Mail Survey

Table 3A-5
Comments from the Mail Survey

Table 3A-6
Number of Fishing Trips

Table 3A-7
Proportion of Trips to Each Site and Site Sizes

Table 3A-1
Selected Statistics from Intercept Survey: May 1 - August 23, 1992
(1,951 observations in the sample)

Intercept Survey Question		Mean (standard error of mean)	Total Number of Responses
Set Up Questions			
Percent who took intercept trip in:	May June July August	25.2% 27.4% 29.0% 18.4%	1,951
Percent who were intercepted on a:	Weekday Weekend	43.2% 56.8%	1,933
Rain or bad weather on day of intercept:	No Yes	91.2% 8.8%	1,843
Percent who were intercepted between:	7:30 am - 2:30 pm 11:00 am - 6:00 pm 2:30 pm - 9:30 pm	19.3% 53.0% 27.7%	1,930
Percent of intercepted anglers who are:	Senior Adult Juvenile	8.5% 83.5% 8.0%	1,937
Percent who are male		89.8%	1,931
Percent doing float trip		33.6%	1,911
Percent using a fly rod		56.9%	1,851
Status of angler's trip when intercepted:	Trip complete Trip incomplete Trip just starting	29.1% 40.0% 30.9%	1,893
Survey Questions About Intercept Trip			
Percent who answered at least some questions (Q1)		98%	1,951
Residence status of intercepted anglers (Q2):	Full-time MT resident Part-time MT resident Nonresident	59.7% 2.8% 37.5%	1,906
Primary purpose of living in Montana (part-time residents only) (Q2):	Fish or hunt Work Other reason	33.3% 36.1% 30.6%	72
Percent for whom fishing was primary purpose of intercepted trip (Q3)		77.9%	1,868

Table 3A-1 (cont.)
Selected Statistics from Intercept Survey: May 1 - August 23, 1992
(1,951 observations in the sample)

Intercept Survey Question		Mean (standard error of mean)	Total Number of Responses
Survey Questions About Intercept Trip (cont).			
Number of large fish caught (Q6): Most anglers did not catch any trout longer than 16 inches. The median number of large trout caught at each of the 26 intensively studied sites is 0.			
Percent who caught other species than trout (Q7)		19.3%	1,645
Survey Questions About Trip Prior to Intercept Trip			
Average number of trips taken prior to intercept trip (Q13)		5.7 (0.927)	1,881
Percent who took trip prior to intercept trip in (Q14):	April	0.4%	
	May	34.1%	
	June	32.5%	
	July	24.7%	
	August	8.2%	939
Percent who visited other site before visiting primary site on this trip (Q15)		30%	1,951
Average number of hours spent fishing at site (Q16)		5.8 (0.415)	956
Average number of trout caught (Q17)		7.2 (0.511)	956
Median number of large trout caught (Q18)		0	889
About the Angler			
Median age (Q19)		38	1,898
Percent employed (Q20):	Full-time	62.6%	
	Part-time	6.6%	1,949
Percent in wage per hour categories (Q21):	Less than $10	30.7%	
	Between $10 and $20	38.8%	
	Greater than $20	30.5%	1,510
Percent on vacation during intercept trip (Q22)		42.2%	1,812
Percent who had previously been intercepted (Q23) Note: Anglers who had already taken the survey once were not followed-up twice		6.0%	1,863

Table 3A-2
Site Destinations of Intercept Trips

	Residents	Nonresidents	Total
Number of intercept trips	1,236 (63% of all trips)	715 (37% of all trips)	1,951 (100%)
Number of intercept trips to single site	1,107 (90% of all resident trips)	373 (52% of all nonresident trips)	1,480 (76% of all trips)
Number of intercept trips to multiple sites	129 (10% of all resident trips)	342 (48% of all nonresident trips)	471 (24% of all trips)
% of multiple-site trips to a single region	84% of all resident multiple-site trips	53% of all nonresident multiple-site trips	62% of all multiple-site trips

Table 3A-3
Summary of Trip Data from the Telephone Survey

	Phase 1 (first telephone call)	Phase 2 (second telephone call)
Total successful contacts	556	339
Percent who took no trips since date of last contact	43.3%	57.2%
Percent who took at least one trip since date of last contact	56.6%	42.8%
Percent who took at least two trips since date of last contact	43.0%	31.6%
Percent who took three or more trips since date of last contact	34.3%	24.2%

Table 3A-4
Selected Statistics from Mail Survey
(505 observations in the sample)

Mail Survey Question	Mean (standard error of mean)	Number of Responses
Average rating of quality of Montana fishing: 1=*very poor*, 7=*excellent* (Q1)	5.18 (0.056)	474
Comments (Q2): Of the 505 respondents to the mail survey, 372 provided at least one written comment. A total of 1,063 comments were made. All mail survey comments are summarized in Table 3A-7 in this Appendix.		
Average number of trips since date of last contact (Q9)	2.95 (0.261)	505
Information on three recent trips (Q10) Percent who took: At least one trip At least two trips Three or more trips	 50.9% 41.8% 35.0%	 505
Questions relating to one trip documented on mail survey (Q11) Average number of nights away from home for: Residents Nonresidents Full sample Median number of nights away from home for: Residents Nonresidents Full sample	 1.04 (0.185) 17.0 (3.954) 4.38 (0.923) 0 7.5 0	 212 56 268 212 56 268

Table 3A-4 (cont.)
Selected Statistics from Mail Survey
(505 observations in the sample)

Mail Survey Question	Mean (standard error of mean)	Number of Responses
Questions relating to one trip documented on mail survey (Q11) (cont.)		
Percent who worked on days they fished	19.8%	263
Average number of days for those who worked	1.85 (0.368)	66
Average total hours spent at the primary site	24.63 (3.537)	243
Average total hours actively fishing at the primary site	10.37 (1.344)	246
Average number of trout caught at the primary site	12.31 (1.561)	245
Average number of other species caught at primary site	3.06 (0.380)	244
Percent fishing for:		
Any type of trout	53.9%	
Rainbow trout only	10.9%	
Brown trout only	9.4%	
No preference	9.0%	
Whitefish or other	16.8%	256
Percent of parties with members engaged in nonfishing recreation	22.0%	255
Average number of years respondents have fished in Montana (Q22)		
Residents	18.63 (0.772)	300
Nonresidents	9.06 (0.725)	191
Average self-assessed skill rating: 1=*novice*, 7=*expert* (Q23)		
Residents	4.86 (0.077)	305
Nonresidents	4.79 (0.095)	194
Average number of people in household (Q24)		
Under age 5	0.21 (0.023)	
Ages 5 - 16	0.56 (0.043)	
Ages 17 - 20	0.13 (0.019)	
Ages 21 - 65	1.75 (0.040)	
Over age 65	0.17 (0.023)	480
Percent who graduated from college (Q25)	52.5%	489
Average number of hours per day respondents spend (Q26):		
Working for wages	6.99 (0.181)	
Doing household chores or childcare	2.08 (0.103)	
Sleeping	7.00 (0.081)	
In school or studying	0.64 (0.097)	486

Table 3A-4 (cont.)
Selected Statistics from Mail Survey
(505 observations in the sample)

Mail Survey Question	Mean (standard error of mean)	Number of Responses
Average number of days per week respondents spend (Q27):		
Working full-time	3.99 (0.100)	
Working part-time	0.42 (0.059)	431
Average number of weeks of paid vacation per year (Q28): (includes all who responded)		
0 - 1	46.0%	
2 - 3	24.9%	
4 and up	29.1%	457
Average income for (Q29):		
Residents	$41,006 (1,847)	256
Nonresidents	$81,672 (4,160)	169
Average hourly wage for (Q30):		
Residents	$15.67 (0.686)	178
Nonresidents	$27.94 (1.378)	108
Average expected wage per hour for (Q31):		
Residents	$15.16 (0.969)	179
Nonresidents	$31.26 (3.984)	94
Percent of nonresidents who travelled by (Q32):		
Automobile	66.1%	
Airplane	29.5%	224
Other	4.5%	
Median airfare for nonresidents who flew (Q32)	$372.50	40
Origin cities of nonresidents who flew (Q32). 40 cities in 19 different states and Canadian provinces were reported.		
Destination cities of nonresidents who flew (Q32). The Montana city into which the greatest percentage of nonresidents flew is Bozeman.		
Median car rental for nonresidents who flew (Q32)	$300.00	33

Table 3A-5
Comments from the Mail Survey

Comment	Times Made
Environmental/Fish, Wildlife and Parks (FWP) Comments	
Someone should monitor and control industrial polluters	5
Someone should monitor and control agricultural polluters	20
FWP or other environmental manager is doing a good job	29
FWP or other environmental manager needs to strengthen its role	27
Stop fish kills resulting from pollution	1
Reduce anglers' pollution	2
Limit development around river	1
Provide more fishing information to anglers	1
Miscellaneous environmental/FWP comments	49
Stock and Number of Fish Comments	
Increase stocking/want more fish	32
Increase stock fish size	7
Stock "my" area more	1
Miscellaneous stock comments	15
Catch and Release/Size Limits	
Increase number of catch and release rivers	80
Reduce the catch limit	19
Increase the catch limit	1
Flies and lures areas only (no live bait)	18
No barbed lures or flies	10
Reduce unnecessary killing of fish by anglers	7
Set slot limits on size	18
Miscellaneous about catch, catch limits, size limits	24

Table 3A-5 (cont.)
Comments from the Mail Survey

Comment	Times Made
Regulations/Enforcement Issues	
Restrict fishing season	11
Enforce current catch limits more effectively	10
Enforce current license laws more effectively	9
Do not raise fees; they are just right	1
Reduce number of allowable river outfitters and guides/charge outfitters more	35
Charge out-of-staters more/limit number of out-of-staters	5
Miscellaneous regulations/enforcement comments	18
Access Issues	
Improve access to rivers	31
More handicapped/elderly access	3
Improve or add facilities	13
Access to more sites	39
Miscellaneous access comments	16
Site Comments	
Big Hole 2 is an excellent site	1
Missouri is an excellent site	1
Upper Clark Fork is an excellent site	1
Madison 2 is a excellent site	1
Rock Creek is an excellent site	2
Big Hole 2 is an average site	1
Big Hole 2 is a poor site	5
Missouri is a poor site	4
Upper Clark Fork is a poor site	3
Madison 2 is a poor site	2
Jefferson 2 is a poor site	1
Rock Creek is decreasing in quality	2
Miscellaneous site comments	48

Table 3A-5 (cont.)
Comments from the Mail Survey

Comment	Times Made
Survey Comments	
Good job on survey, glad I could help	29
Survey is waste of time/money	3
Would be interested in results, please send	2
Questions are inappropriate	2
Improve survey by shortening	1
Miscellaneous comments about the survey	3
Flow Comments/Regulation of Flow	
Reduce drainage of rivers and streams by agriculture/industry	37
General -- flow is too low	34
Miscellaneous flow comments	18
Miscellaneous Recurring Comments	
Everything is just right/do not change anything	7
Rivers congested by anglers	15
Fishing is poor this year	6
Fishing is good this year	23
Do not know enough/cannot comment	45
Allow only bank fishing	11
See gradual decline in Montana fishing	6
Montana becoming too expensive	3
Increase length of fishing season	3
Reduce/ban number of motorized boats	3
Other miscellaneous comments	181

Table 3A-6
Number of River and Stream Fishing Trips in Montana: May - September 1992

	Mean	Median	Number of Observations
Full sample	13.05	7.00	443
Residents	17.87	13.00	291
Nonresidents	3.81	2.00	152
Missoula residents	22.29	14.50	42
Bozeman residents	16.40	13.00	43

Table 3A-7
Proportion of Trips to Each Site and Site Sizes
(proportion of trips to 26 sites)

	Full Sample (N=443)	
River	Proportion of Trips	Size = Flow x Length
UCF 1	0.026	31,787
UCF 2	0.011	14,404
UCF 3	0.004	10,526
Middle CF	0.049	125,175
Rock Cr.	0.065	21,240
Flint Cr.	0.013	940
Bitterroot 1	0.038	69,975
Bitterroot 2	0.074	32,714
Lolo Cr.	0.012	2,400
Blackfoot	0.026	64,543
L. Blackfoot	0.017	3,030
UCF 4	0.007	6,840
UCF 5	0.015	456
Silver Bow Cr.	0.001	1,134
WSC	0.003	490
Big Hole 1	0.057	40,509
Big Hole 2	0.061	25,077
Jefferson 2	0.038	46,721
Beaverhead	0.049	7,020
Jefferson 1	0.017	46,721
Missouri	0.145	49,311
Yellowstone	0.038	116,662
Gallatin	0.040	33,218
E. Gallatin	0.024	1,120
Madison 1	0.058	18,216
Madison 2	0.113	46,255

APPENDIX 4A

THE RECREATION DEMAND MODEL OF PARTICIPATION, SITE CHOICE, AND EXPECTED CATCH RATES

The Travel-Cost Component of the Model: A Repeated Nested-Logit Model of Participation and Site Choice

Assume that the fishing season can be divided into 60 periods such that in each period the individual can take at most one fishing trip. In each period the individual decides both whether and where to fish. The individual will choose the alternative that provides the greatest utility. The utility the individual receives during period p if he chooses alternative j is:

(1) $U_{jp} = V_j + \epsilon_{jp}$; j = 0, UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF, RMo, UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1, RBUo, MS, RHo, LY, G, EG, MD1, MD2, RBZo, RO

where j = 0 is the nonfishing alternative and UCF1 - LBF, UCF4 - J1, MS, and LY - MD1 are abbreviations for the 26 intensively studied sites in the four regions (see Table 2-1). The sites in the Missoula region, RM, are UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF, and RMo, where RMo is a collective of all the other sites in the Missoula region. The Butte region, RBU, is UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1, and RBUo. The Helena region, RH, has just two sites, MS and R3o, and the Bozeman region, RBZ, is LY, G, EG, MD1, MD2, and RBZo. RO is a collective of all the river and stream sites in Montana that are not in one of the four regions in Southwestern Montana.

The term V_j depends on the cost and characteristics of alternative j and is deterministic from both the individual's and the researcher's perspective. Alternatively, ϵ_{jp} is known to the individual, but varies from period to period, across individuals and across sites in a way the researcher cannot observe. Therefore ϵ_{jp} and U_{jp} are random variables from the researcher's perspective.

Assume the ϵ_{jp} are drawn from the generalized extreme value distribution with distribution function:

$$(2) \quad F(\epsilon) = \exp[-e^{-s\epsilon_0} - [(E_M)^{t/s} + (E_{BU})^{t/s} + (E_H)^{t/s} + (E_{BZ})^{t/s} + (E_O)^{t/s}]^{1/t}]$$

where s is a statistical parameter that influences the degree of unobserved correlation between the utility from trips to any two sites in the same region, t is a statistical parameter that influences the degree of unobserved correlation between the utility from trips to any two fishing sites,[1] and:

[1] A sufficient, but not necessary, condition for this density function to be well-behaved is $s > t > 0$. This condition is fulfilled (see Table 5C-1).

(3) $E_M = e^{s\epsilon_{UCF1}} + e^{s\epsilon_{UCF2}} + e^{s\epsilon_{UCF3}} + e^{s\epsilon_{MCF}} + e^{s\epsilon_{RC}} + e^{s\epsilon_{FC}} + e^{s\epsilon_{BT1}} + e^{s\epsilon_{BT1}} + e^{s\epsilon_{LC}} + e^{s\epsilon_{BF}} + e^{s\epsilon_{LBF}} + e^{s\epsilon_{RMo}}$

(4) $E_{BU} = e^{s\epsilon_{UCF4}} + e^{s\epsilon_{UCF5}} + e^{s\epsilon_{SBC}} + e^{s\epsilon_{WSC}} + e^{s\epsilon_{BH1}} + e^{s\epsilon_{BH2}} + e^{s\epsilon_{J2}} + e^{s\epsilon_{BV}} + e^{s\epsilon_{J1}} + e^{s\epsilon_{RBUo}}$

(5) $E_H = e^{s\epsilon_{MS}} + e^{s\epsilon_{RHo}}$

(6) $E_{BZ} = e^{s\epsilon_{LY}} + e^{s\epsilon_{G}} + e^{s\epsilon_{EG}} + e^{s\epsilon_{MD1}} + e^{s\epsilon_{MD2}} + e^{s\epsilon_{RBZo}}$

(7) $E_{RO} = e^{s\epsilon_{RO}}$

This generalized extreme value function generates a three-level nested logit model of participation and site choice.

Given this Cumulative Density Function (CDF), the per-period probability that an individual will choose not to fish is:

(8) $$Prob_0 = \frac{e^{sV_0}}{e^{V_0} + [(I_M)^{t/s} + (I_{BU})^{t/s} + (I_H)^{t/s} + (I_{BZ})^{t/s} + (I_{RO})^{t/s}]^{1/t}}$$

where:

(9) $I_M = e^{sV_{UCF1}} + e^{sV_{UCF2}} + e^{sV_{UCF3}} + e^{sV_{MCF}} + e^{sV_{RC}} + e^{sV_{FC}} + e^{sV_{BT1}} + e^{sV_{BT2}} + e^{sV_{LC}} + e^{sV_{BF}} + e^{sV_{LBF}} + e^{sV_{RMo}}$

(10) $I_{BU} = e^{sV_{UCF4}} + e^{sV_{UCF5}} + e^{sV_{SBC}} + e^{sV_{WSC}} + e^{sV_{BH1}} + e^{sV_{BH2}} + {}^{sV_{J2}} + e^{sV_{BV}} + e^{sV_{J1}} + e^{sV_{RBUo}}$

(11) $I_H = e^{sV_{MS}} + e^{sV_{RHo}}$

(12) $I_{BZ} = e^{sV_{LY}} + e^{sV_{G}} + e^{sV_{EG}} + e^{sV_{MD1}} + e^{sV_{MD2}} + e^{sV_{RBZo}}$

(13) $I_{RO} = e^{sV_{RO}}$

The per-period probability the individual will choose site j in the Missoula region (j = UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF, RMo) is:

$$(14) \quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{(1/t)-1}\ (I_M)^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{1/t}}$$

The per-period probability the individual will choose site j in the Butte Region (j = UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1, RBUo) is:

$$(15) \quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{(1/t)-1}\ (I_{BU})^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{1/t}}$$

The per-period probability the individual will choose site j in the Helena Region (j = MS, RHo) is:

$$(16) \quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{(1/t)-1}\ (I_H)^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{1/t}}$$

The per-period probability the individual will choose site j in the Bozeman Region (j = LY, G, EG, MD1, MD2, RBZo) is:

$$(17) \quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{(1/t)-1}\ (I_{BZ})^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{1/t}}$$

And, the per-period probability the individual will choose a site in Montana that is not in one of the four regions in Southwestern Montana is:

$$(18) \quad Prob_{RO} = \frac{e^{sV_{RO}}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{(1/t)-1}\ (I_{RO})^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{RO})^{t/s}]^{1/t}}$$

Specifically, assume the V_j for a fishing trip to site j, where j is one of the 26 intensively studied sites, is a function of the following variables: the angler's cost of a trip to site j, $COST_j$; the expected catch rate at site j, ECR_j; the size of site j, SZ_j; the angler's per-period income, PPY (which is equal to *full income* divided by 60 periods -- full income is defined in Appendix 5A); and a region-specific constant, D_{Rk}, for the region in which the site is located (k = M, BU, H, and BZ).

$$(19) \quad V_j = \beta_0(PPY - COST_j) + \beta_{00}(PPY - COST_j)^{.5} + \beta_{SZ}(SZ_j) + \beta_{ECR}(ECR_j) + \beta_{ECRNR}(NRES)(ECR_j) + D_{Rk}$$

where NRES = 1 if the angler is not a resident of Montana and zero if the angler is a resident. Note ($PPY - COST_j$) is the amount of money the individual has left to spend on other goods in period t if the individual takes a trip to site j. The nonlinear term $\beta_{00}(PPY - COST_j)^{.5}$ is the term that admits income effects into the model and makes WTP a function of the angler's income.[2]

If the trip is to a site in one of the four regions (Missoula, Butte, Helena, or Bozeman), but not to one of the intensively-studied sites, assume:

$$(20) \quad V_j = \beta_0(PPY - AveCOST_{Rk}) + \beta_{00}(PPY - AveCOST_{Rk})^{.5} + D_{Rk} + D_{Rko}$$

where the individual's cost of a trip to the *collective* site in region k is assumed to be the average of the individual's trip costs for the intensively studied sites in region k. Since the collective sites are catch-alls for trips to sites other than the intensively studied sites, there is unobserved variation across trips to each collective site in terms of site size and expected catch rate. Therefore, size and expected catch rate cannot be included as explicit determinants of the utility an angler receives from a trip to a collective site. Their influence is replaced with a second region-specific constant term, D_{Rko}.

If the trip is to a site that is not in one of the four explicit regions in Southwestern Montana, assume:

$$(21) \quad V_{RO} = \beta_0(PPY) + \beta_{00}(PPY)^{.5} + D_{RO}$$

Note in this case there is no information about trip costs, so even though trip cost is positive it cannot be included as an explicit determinant of the utility the angler receives from a trip to this *fifth* region. Its influence must be accounted for by the fifth-region constant, D_{RO}.

If an individual does not take a fishing trip in period t, that individual will have PPY to spend on other goods and V_O is:

[2] For a few individuals with very low incomes and high trip costs, ($PPY - COST_j$) is occasionally negative. When this occurs, $(PPY - COST_j)^{.5}$ is an imaginary number so ($PPY - COST_j$) is set to zero.

$$(22) \quad V_0 = \beta_0(PPY) + \beta_{00}(PPY)^{.5} + \beta_{0NR}(NRES)(PPY) + \beta_{00NR}(NRES)(PPY)^{.5}$$

$$+ \beta_G(G) + \beta_{SK}(SK) + \beta_{MTF}(MTF) + \beta_{FT}(FT) + \beta_A(A) + \beta_v(V) + \beta_{NR}(NRES) + D_P$$

where G is the angler's gender (1 = female), SK is self-assessed fishing skill, MTF is years fished in Montana, FT is reported hours of free time in a typical weekday, A is age,[3] V is weeks of paid vacation, and D_P is a constant term.[4]

The Catch Component of the Model

Define CR_{hm} as the catch rate reported by the mth individual intercepted at site h. Assume each CR_{hm} is an unbiased estimate of the expected catch rate at site h:

$$(23) \quad CR_{hm} = ECR_h + \mu_{hm}$$

where μ_{hm} is uncorrelated with ϵ_{jp}, and μ_{hm} is normally distributed with mean zero and variance assumed proportional to the mean. The ECR are unobserved. There was no reason to assume the μ_{hm} are homoscedastic. The most general assumption would have been to allow the variances to be different for every site, but this would have introduced 26 additional parameters. Our assumption that the variance on μ_{hm} is proportional to the mean over m is consistent with the data. The μ_{hm} vary across sites and m because of unobserved variations in weather, flow rates, insect hatches, time of day, skill level, etc. That μ_{hm} and ϵ_{jp} are uncorrelated follows from our belief that fishing skill is not site specific; skilled anglers are skilled at all sites and low-skilled anglers are low-skilled at all sites.

Expected catch rates are the link between the catch rate and travel-cost components of the model in that they are parameters in both components.

The log likelihood function for this joint model is reported in Appendix 5C.

---

[3] In early stages of the analysis, a linear model was estimated that regressed anglers' total number of trips on various demographic variables to help us to decide which variables to include in equation (22). AGE^2 was considered but was not statistically significant and led to a decrease in the adjusted R^2. Consequently, AGE^2 was not included in the recreation demand model.

[4] These functional forms for the indirect utility functions in equations (19) through (22) provide first-order approximations in terms of all variables except for (PPY - $COST_j$), for which they provide second-order approximations. Most estimated discrete choice models assume the indirect utility functions are strictly linear functions of the variables.

APPENDIX 5A

CALCULATION OF TRIP COSTS AND FULL INCOME

CALCULATION OF TRIP COSTS

Residents

The cost of a trip to site j by a resident of Montana is (round trip distance from the individual's residence to site j) multiplied by (per-mile vehicle operating costs) + (average lodging expenses by one-way distance category) + (average equipment expenses by one-way distance category) + [(travel and on-site time) multiplied by (the opportunity cost of the individual's free time)].

Distances were calculated using the shortest possible routes on interstate highways and major roads. Travel costs and time are based on the estimated travel miles.

Average resident costs for lodging, equipment, and on-site time for a trip were then determined for each of four distance categories. The one-way distances from each point of origin to each site were grouped into categories of 0-25 miles, 26-50 miles, 51-150 miles, and greater than 150 miles. Average lodging expenses and equipment expenses by distance category are in Table 3-7.

For the purpose of the recreation demand model, interviewees who stated they are part-time residents on the intercept survey were treated as residents. Distances from part-time residents' Montana homes were calculated from the city or town in Montana identified in Q2 on the intercept survey.

According to the Montana Department of Labor and Industry, the state government of Montana paid its employees $0.275 per mile in 1992 to drive their own cars for job-related activities. The federal government allowed a tax deduction of $0.28 per mile for vehicle operating expenses incurred for work related activities. To be conservative, we used $0.275 as our per-mile vehicle operating expense.

For residents, travel time is the round trip distance divided by 45, where 45 m.p.h. is the assumed average travel speed for trips by Montana residents to our 26 intensively studied sites and was chosen based on study-team members' and survey agents' visits to the sites. Average on-site time by distance category is in Table 3-6.

The opportunity cost of each individual's free time (for residents and nonresidents) is assumed to be his or her wage rate multiplied by some fraction, β_w , where β_w is an estimated parameter in the model. That value is 0.6.

Nonresidents

Nonresidents were separated into two groups: those for whom the cheapest method to travel to Montana is to fly and those for whom the cheapest method is to drive.

Transportation costs for nonresidents were calculated using the cheapest method of travel. For nearby states such as Idaho, the costs of travelling by car are cheaper than by plane. For more distant states such as New York, it is cheaper to travel by plane. In Q32 on the mail survey, nonresidents were asked to report the airfare and car rental fees they paid when they travelled to Montana on their last trip if they flew. The data indicate average airfare and car rental rates do not vary much across states or national regions. The median airfare is $372.50, and the median car rental fee is $300. Adding the two costs together yields $672.50. Using the vehicle operating expense of $0.275 per mile, an individual can drive for 2,450 miles round trip for $672.50.

Butte, Montana was chosen as an approximate geographic center for the 26 sites. For nonresidents within the 1,225 mile radius from Butte, costs were measured using driving expenses. For all nonresidents beyond the 1,225 mile limit, costs were calculated using plane and car rental expenses which would be cheaper than driving costs. States (and Canadian provinces) within the 1,225 mile limit include Alberta, California, Colorado, Idaho, Kansas, Minnesota, New Mexico, Nevada, Oregon, Saskatchewan, Utah, Washington, and Wyoming. Nonresidents outside the limit came from Alaska, Arizona, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Louisiana, Massachusetts, Maryland, Michigan, Missouri, North Carolina, New Hampshire, New Jersey, New York, Oklahoma, Pennsylvania, Texas, Vermont, and Wisconsin.

Distances for nonresidents from adjacent states to Montana were calculated by first measuring the distance from nonresidents' homes to the nearest zip code in Montana for which we had calculated residents' distances. The distances to all of the sites from those zip codes were subsequently added.

For nonresidents for whom driving is the cheapest travel method from states which are not adjacent to Montana, distances were calculated from the population center nearest to the nonresidents' homes to Butte. Variations in distances to each site were not included for this group because they are such a tiny proportion of the total distance.

The cost of a trip to site j for a nonresident living in an adjacent state is (round trip distance from the individual's residence to site j) multiplied by (per-mile vehicle operating costs) + (average lodging expenses for nonresidents) + (average equipment expenses for nonresidents) + [(travel time and average on-site time for nonresidents) multiplied by (the opportunity cost of the individual's time)].

The time spent on a fishing trip to site j for a nonresident living in an adjacent state includes the total travelling time to site j assuming an average speed of 60 m.p.h. outside of Montana and 45 m.p.h. once the nonresident angler reaches the Montana zip code from which he or she travels to site j. Average on-site time for nonresidents is reported in Table 3-6.

The cost of a trip to site j for a nonresident who does not live in an adjacent state but who resides within 1,225 miles of Butte is the (round trip distance from a population center near individual i's residence to Butte[1]) multiplied by (per-mile vehicle operating costs) + (average lodging expenses for nonresidents) + (average equipment expenses for nonresidents) + [(travel time and average on-site time for nonresidents) multiplied by (the opportunity cost of the individual's time)].

The time spent on a fishing trip to site j for a nonresident who does not live in an adjacent state but resides within 1,225 miles of Butte includes the total travelling time to Butte assuming an average speed of 60 m.p.h.

The cost of a trip to site j for a nonresident who resides more than 1,225 miles from Butte is the (median airfare for sample who flew) + (median car rental payment for sample who flew) + (average lodging expenses for nonresidents) + (average equipment expenses for nonresidents) + [(travel time and average on-site time for nonresidents) multiplied by (the opportunity cost of the individual's time)].

The travel time for flying has two components:

1. The average air time and stopover time for airplane flights from the city with an airport nearest to the nonresident's home to Bozeman, the city into which most flying nonresidents actually flew according to responses to Q32 on the mail survey.

2. The average time to get to any of the 26 sites from Bozeman, 2.5 hours.

CALCULATION OF FULL INCOME

Full income is calculated as 1991 total household income before taxes and deductions plus the opportunity cost of free time. The opportunity cost of free time is the opportunity cost of an individual's time multiplied by the total amount of free time. On average, full income is about 41 percent higher than 1991 total household income before taxes and deductions for both residents and nonresidents.

[1] The distance for this group is always less than 2,450 miles. Otherwise it would be cheaper to fly.

APPENDIX 5B

THE LOG LIKELIHOOD FUNCTION

THE LOG LIKELIHOOD FUNCTION FOR THE RECREATION DEMAND MODEL

For each of the 443 anglers in the recreation demand data set, there is a record of how many fishing trips he or she took during the 1992 summer season, but not a complete record of where each angler went for each trip.

An angler's fishing trips were allocated to one of the following 36 site categories on the basis of the information available for each trip:

T_{UCF1} ,T_{UCF2} ,.....,T_{LBF} = Number of trips to each of the 11 intensively studied sites in the Missoula region (UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF)

T_{RMo} = Number of trips that were to single sites in the Missoula region that are not intensively studied sites

T_{RM} = Number of trips where each trip involved multiple sites in the Missoula region but no sites in other regions

T_{UCF4} ,T_{UCF5} ,.....,T_{J1} = Number of trips to each of the nine intensively studied sites in the Butte region (UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1)

T_{RBUo} = Number of trips that were to single sites in the Butte region that are not intensively studied sites

T_{RBU} = Number of trips where each trip involved multiple sites in the Butte region but no sites in other regions

T_{MS} = Number of trips to the intensively studied Missouri site in the Helena region (MS)

T_{RHo} = Number of trips that were to single sites in the Helena region that are not the intensively studied stretch of the Missouri

T_{RH} = Number of trips where each trip involved multiple sites in the Helena region but no sites in other regions

T_{LY} ,T_{G} ,.....,T_{MD2} = Number of trips to each of the five intensively studied sites in the Bozeman region (LY, G, EG, MD1, MD2)

T_{RBZo} = Number of trips that were to single sites in the Bozeman region that are not intensively studied sites

T_{RBZ} = Number of trips where each trip involved multiple sites in the Bozeman region but no sites in other regions

T_{RO} = Number of trips to rivers or streams in Montana that are not in the Missoula, Butte, Helena, or Bozeman subregions

T_O = Number of trips where each trip involved multiple regions or where there is no information about the site or sites visited except that each trip involved river or stream fishing in Montana.

The number of periods the individual chose not to fish, N, is 60 minus the individual's total number of fishing trips.

The per-period probability of nonparticipation ($Prob_0$), the per-period probabilities associated with the four region-specific collective sites for Southwestern Montana ($Prob_{RMo}$, ..., $Prob_{RBZo}$), the per-period probability of choosing a site in another part of Montana ($Prob_{RO}$), and the per-period probabilities for the 26 intensively studied sites ($Prob_{UCF1}$, $Prob_{UCF2}$, ..., $Prob_{MD2}$) are all defined in Appendix 4A. The per-period probability of a trip to multiple sites in region k (k = M, BU, H, BZ) is modelled as the per-period probability that region k will be chosen. Denote this per-period probability $Prob_{Rk}$. For example, $Prob_{RM}$ is the per-period probability the Missoula region will be chosen where $Prob_{RM} = Prob_{UCF1} + Prob_{UCF2} + ... + Prob_{LBF} + Prob_{RMo}$.

The Log of the Likelihood function for the travel-cost component of the model is:

$$(1) \quad L_{tc} = \sum_{i=1}^{443} [N*\ln(Prob_0) + T_O*\ln(Prob_O) + T_{RO}*\ln(Prob_{RO})$$

$$+ T_{RM}\ln(Prob_{RM}) + T_{RBU}\ln(Prob_{RBU}) + T_{RH}\ln(Prob_{RH}) + T_{RBZ}\ln(Prob_{RBZ})$$

$$+ T_{RMo}\ln(Prob_{RMo}) + T_{RBUo}\ln(Prob_{RBUo}) + T_{RHo}\ln(Prob_{RHo}) + T_{RBZo}\ln(Prob_{RBZo})$$

$$+ \sum_{j=1}^{26} T_j*\ln(Prob_j)]$$

where the subscript j indexes the 26 intensively studied sites. The N variable, all the T variables, and all the probabilities (Prob) are indexed on i; the i subscript is suppressed for notational simplicity. This component of the Log of the Likelihood function is a function all 53 parameters in the model, the data on site sizes, the zero expected catch rate for Silver Bow Creek, and the data for each of the 443 anglers on trips, trip costs, income, gender, age, residency, skill, years fished in Montana, free time, and weeks of paid vacation. The parameters include the 25 expected catch rates.

In addition to the travel-cost data, individual catch rates were collected at each of the 26 intensively studied sites (except Silver Bow Creek) where CR_{hm} is the reported catch rate by the mth individual intercepted at site h. This additional data, along with the assumptions made about the relationship between observed catch rates and expected catch rates (Appendix 4A: equation (23)) adds the following term to the Log of the Likelihood function:

$$(2) \qquad L_c = \sum_{h=1}^{25} \sum_{m=1}^{M_h} \left[- \ln(\sigma_h) - .5 \frac{(CR_{hm} - ECR_h)^2}{\sigma_h^2} \right]$$

This component of the Log of the Likelihood function is a function of the 25 expected catch rate parameters and the 1,380 observed catch rates.

Given our earlier assumption that the random term in the travel-cost component of the model are uncorrelated with the random term in the relationship between individual catch rates and the expected catch rates, the likelihood function for the joint model of participation, site choice and expected catch rates is $L = L_{tc} + L_c$.

APPENDIX 5C

ADDITIONAL MODEL ESTIMATES

Table 5C-1
Parameter Estimates

Table 5C-2
Proportions of Resident Trips to Each Site

Table 5C-1
Parameter Estimates

Parameter		Full Sample	
		Estimate	t Statistic
Expected catch rates	ECUCF1	0.452	9.603
	ECUCF2	0.335	5.373
	ECUCF3	0.190	2.512
	ECMCF	0.158	1.917
	ECRC	0.778	15.909
	ECFC	0.536	9.359
	ECBT1	0.332	6.469
	ECBT2	0.743	16.547
	ECLC	0.437	7.156
	ECBF	0.317	6.077
	ECLBF	0.450	7.942
	ECUCF4	0.276	3.956
	ECUCF5	0.497	8.881
	ECWSC	0.155	1.565
	ECBH1	0.655	14.616
	ECBH2	0.725	15.946
	ECJ2	0.477	10.152
	ECBV	0.860	16.856
	ECJ1	0.316	6.051
	ECMS	0.364	6.514
	ECLY	0.511	11.306
	ECG	0.357	6.934
	ECEG	0.349	6.220
	ECMD1	0.512	12.040
	ECMD2	0.697	14.609
Parameters on expected catch rates	β_{ECR}	0.166	8.269
	β_{ECRNR}	0.102	6.089

Table 5C-1 (cont.)
Parameter Estimates

Parameter		Full Sample	
		Estimate	t Statistic
Parameters on income and trip costs	β_0	0.352E-03	7.134
	β_{00}	0.239E-01	8.682
	β_{0NR}	-0.716E-04	-0.779
	β_{00NR}	0.112E-01	1.771
	β_W	0.599	27.520
Parameters for the five regions	D_{RM}	-0.247	-4.887
	D_{RBU}	-0.294	-5.870
	D_{RH}	-0.304	-6.122
	D_{RBZ}	-0.215	-4.257
	D_{RO}	-0.870	-15.319
Parameters for the four collective sites	D_{RMO}	0.167	11.878
	D_{RBUO}	0.163	11.431
	D_{RHO}	0.623E-01	4.286
	D_{RBZO}	0.142	9.969
Statistical parameters	s	25.817	85.337
	t	4.486	44.448
	sd	1.915	55.595
Parameter to determine number of trips	D_P	2.713	36.703
Parameters on angler characteristics	β_{SZ}	0.801E-07	6.302
	β_G	0.258	4.671
	β_A	0.005	3.622
	β_{SK}	-0.446	-34.236
	β_{MTF}	0.023	15.246
	β_{FT}	-0.039	-8.796
	β_V	0.092	8.848
	β_{NR}	1.025	10.114

Table 5C-2
Proportions of Resident Trips to Each Site
Actual and Predicted
(proportion of trips to 26 sites)

River	Missoula Residents		Bozeman Residents	
	Actual	Predicted	Actual	Predicted
UCF 1	0.103	0.048	0.000	0.008
UCF 2	0.041	0.014	0.000	0.026
UCF 3	0.028	0.003	0.000	0.018
Middle CF	0.290	0.107	0.000	0.009
Rock Cr.	0.207	0.117	0.012	0.036
Flint Cr.	0.007	0.016	0.000	0.034
Bitterroot 1	0.076	0.049	0.000	0.004
Bitterroot 2	0.041	0.043	0.000	0.019
Lolo Cr.	0.028	0.023	0.000	0.002
Blackfoot	0.117	0.053	0.000	0.006
L. Blackfoot	0.000	0.005	0.000	0.049
UCF 4	0.000	0.020	0.000	0.004
UCF 5	0.000	0.030	0.000	0.010
Silver Bow Cr.	0.000	0.003	0.000	0.002
WSC	0.000	0.007	0.000	0.002
Big Hole 1	0.000	0.044	0.006	0.059
Big Hole 2	0.000	0.061	0.030	0.039
Jefferson 2	0.007	0.025	0.000	0.050
Beaverhead	0.000	0.008	0.012	0.052
Jefferson 1	0.000	0.011	0.006	0.045
Missouri	0.041	0.137	0.018	0.140
Yellowstone	0.000	0.013	0.115	0.039
Gallatin	0.000	0.019	0.170	0.096
E. Gallatin	0.000	0.010	0.133	0.053
Madison 1	0.000	0.050	0.285	0.096
Madison 2	0.014	0.085	0.212	0.101

APPENDIX 6A

CALCULATION OF TROUT STOCKS

Trout stocks were calculated for our sites based on data from Don Chapman Consultants (1993) using the following guidelines:

1. Stock data collected by Chapman for stretches of stream and river segments that overlapped with our sites were used.

2. To determine stock estimates at our sites, the stock estimate for a Chapman stretch of river was multiplied by the length of the stretch in river miles (rm). These values were summed up over the entire site and divided by total distance to yield a weighted average of the stock.

3. Chapman did not provide stock estimates for every portion of the stream and river segments within all of our sites. Estimates were provided, however, for at least a portion of nine of our sites. Within the nine sites, stock estimates were provided for an area ranging from 35 percent to 100 percent of total sites.

4. In general, Chapman only calculated stocks for one state-type stretch per reach.[1] For example, Upper Clark Fork 3 has two "laid back banks" and two "channelized" stretches. In this case, Chapman only estimated stocks for one of each type of stretch. For stretches within our sites that were not explicitly measured, stock estimates were provided based on similar state-type stretches located within the same reach. Stretches that had no comparable measure of stock were not used in stock calculations.

5. In Upper Clark Fork 4, two stock estimates were provided for two "eroded banks" state-type stretches. These estimates were averaged to provide values for other "eroded banks" stretches in Upper Clark Fork 4 that did not have stock values.

6. For the 0.0-1.2 rm stretch and the 3.2-5.09 rm stretch at Rock Creek, two stock estimates were provided for each area because of differences in the ecological and geographical composition of these stretches.[2] In these cases, the stock values we used were the averages of the two estimates.

7. Stretches of river selected by Chapman did not always overlap perfectly with stretches contained within our sites. For this reason, we eliminated from our calculations the area of the Chapman stretches that were not part of our sites. In order to determine whether stretches within our sites matched up with stretches sampled by Chapman, geographical landmarks and estimates of river miles from

[1] Two stretches are of similar state-type if they have similar ecological and geographical characteristics.

[2] River mile 0.0 is at the confluence of the river.

the confluence were used. Geographic landmarks were used to determine the length of stretches for the Clark Fork sites and Silver Bow Creek. Estimates of river miles from the confluence were used for Big Hole 1, Beaverhead, and Rock Creek.

APPENDIX 7A

DERIVATION OF WTP AND WTA

Derivation of WTP and WTA for the baseline expected catch rates at the Clark Fork River and Silver Bow Creek

The details of the recreation demand model are presented in Appendix 4A. This appendix only explains the derivation of WTP and WTA from the model. Variables and parameters not defined here were defined in Appendix 4A.

Define per-period expected maximum benefits as:

(1) $V = V(PPY, COST, ECR, SZ, NRES, G, SK, MTF, FT, A, V)$

where *COST*, *ECR*, and *SZ* are each 26×1 vectors with one element for each of the 26 intensively studied sites; for example:

$$COST \equiv COST(COST_{UCF1}, COST_{UCF2}, \ldots, COST_{MD2}) \ .$$

Per-period WTP and WTA for the baseline expected catch rates can be defined in terms of per-period expected net benefits. Define ECR^0 as the expected catch rates that currently exist at the 26 sites given the injuries at the Clark Fork River and Silver Bow Creek. Define ECR^1 as the expected catch rates that would exist at the 26 sites if there were no injuries to the Clark Fork River and Silver Bow Creek. Per-period WTP for the baseline expected catch rates is defined as the amount the angler's per-period income would have to decrease if the baseline expected catch rates existed to equate expected maximum benefits with the baseline expected catch rates and expected maximum benefits with the current expected catch rates. Specifically, per-period WTP, WTP_p, is:

(2) $V(PPY, ECR^0, \Gamma) = V(PPY-WTP_p, ECR^1, \Gamma)$

where Γ denotes all of the other variables that determine expected maximum benefits. The elements of Γ are identified in equation (1).

Per-period WTA the current expected catch rates rather than the baseline expected catch rates is the amount the angler's per-period income would have to increase to make the angler's expected maximum benefits with the injury-level expected catch rates and increase in income equal to his expected maximum benefits with the baseline expected catch rates and the original level of per-period income. Specifically, per-period WTA, WTA_p, is:

(3) $V(PPY+WTA_p, ECR^0, \Gamma) = V(PPY, ECR^1, \Gamma)$

Given the specification of the recreation demand model, expected maximum benefits are:

$$(4) \qquad V = \ln[e^{V_0} + [(I_M)^{q_s} + (I_{BU})^{q_s} + (I_H)^{q_s} + (I_{BZ})^{q_s} + (I_{RO})^{q_s}]^{1/r}] + 0.57$$

where 0.57 is Euler's constant.

Given the inclusion of income effects in the conditional indirect utility functions (equations (19)-(22) in Appendix 4A), there is no closed-form solution for either WTP_p or WTA_p. However, one can numerically solve for either WTP_p or WTA_p for any change in expected catch rates for any angler as a function of the angler's per-period income, trip costs, and other characteristics. We determined WTP_p for each of the 443 anglers in our sample using the optimization procedure in *Gaussi* (Optimum) to find the WTP_p that minimized:

$$[V(PPY, ECR^0, \Gamma) - V(PPY-WTP_p, ECR^1, \Gamma)]^2$$

for each angler.

Total WTP and WTA for the summer season are obtained by multiplying WTP_p and WTA_p by 60, the number of periods.

APPENDIX 8A

1992 RECREATIONAL BOATING SURVEY

1992 RECREATIONAL BOATER USE SURVEY FOR NON-ANGLERS

INTERVIEWER CODE _____ RIVER CODE _____
SITE OF INTERVIEW _____ MONTH/DAY _____

Circle Type of Watercraft:

Raft	Drift/John Boat	Kayak	Other_____
Inner tube	Canoe	Motorboat	(Please specify)

Hello, my name is _____. I'm conducting a floating use survey for the MT Dept. of Fish, Wildlife, and Parks. It would help us in the management of this river if I could ask you a few questions about your float trip. May we have your help? 1 No 2 Yes >> Continue

R1 Are you a full-time or part-time resident of Montana, or a non-resident?

1 FULL-TIME RESIDENT → County of Residence _____
2 PART-TIME RESIDENT (owns or rents in Mt) → Nearest City/Town _____
3 NON-RESIDENT ↓
State of Residence (if part-time or Non-resident)_____

R2 At what location did you put in your craft? _____(nearest landmark)

R3 At what location will you take out? _____ _____(nearest landmark)

R4 Was this a commercial or private trip? Circle one: Private. Commercial

R5 Was floating the primary purpose of your trip? _____
(A "trip" is any time you leave home or your part-time residence).

R6 What were other recreational activities you participated in along the river on this trip? Please check all that apply:

Birdwatching	____	Camping	____	Gold Panning	____
Hiking	____	Peak Climbing	____	Picnicking	____
Rock Climbing	____	Rock Collecting	____	Swimming	____
Wildlife Viewing	____	Other (Please list)	_____		

_____

To better manage this and other rivers in Montana, we may want to contact you by mail or phone to find out more about your float trip. The follow-up will only take a small amount of your time. Would you be willing to help us by giving your name and address?

1 Yes >>

NAME_____
ADDRESS_____
CITY_____STATE___ZIP_____
PHONE_____

2 No

Thank you for participating in our study!

APPENDIX 8B

ECONOMIC VALUATION OF NONFISHING RECREATION

STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

Prepared by:

John Duffield

Bioeconomics, Inc.
Missoula, MT

The valuation of nonfishing recreation impacts uses the considerable literature on nonfishing recreational use values to select unit values to be applied to the change in nonfishing recreation trips to the sites under baseline conditions. The unit value methodology may be used under both the current and proposed NRDA regulations: "Unit values are preassigned dollar values for various types of nonmarketed recreational or other experiences by the public. Where feasible, unit values in the region of the affected resource and unit values that closely resemble the recreation or other experience lost with the affected resource may be used." [Proposed 43 CFR § 11.83 (c)(2)(ii)(E); 43 CFR § 11.83 (d)(6).]

In this section, the literature on nonfishing recreation is reviewed to identify an appropriate unit value. One perspective on this issue is to examine the relative magnitude of nonfishing recreational use values compared to fishing recreational use values. Selecting a unit value is somewhat complicated by the mix of different nonfishing recreation activities, each with different net economic values, that would occur along the upper Clark Fork River and Silver Bow Creek under baseline conditions, and because the reported values vary across different studies in different locations. Therefore, the strategy employed here is to select an average value that conservatively reflects the values reported for the applicable recreation activities.

Hagmann (1979) identified the types of nonfishing activities taking place in the upper Clark Fork River and tributaries in 1978 (see Table 8-2). These included floating, walking, picnicking, sightseeing, camping, water play, hunting, and gathering berries and mushrooms. Similarly, the 1992 boating intercept survey (see Table 8-5) found that floaters also enjoyed birdwatching, camping, hiking, picnicking, swimming, and wildlife viewing. Average net benefits per day or per visit have been estimated for many of these nonfishing recreation activities in Montana and throughout the Rocky Mountain West. Both Walsh *et al.* (1988) and Smith and Kaoru (1990) have compiled and summarized such estimates. Estimates from these sources for the Rocky Mountain West for the types of recreation activities that have been impacted along the Clark Fork River and Silver Bow Creek corridors are summarized in Table 8B-1. These estimates apply to each recreation day and have been updated to 1992 dollars. The listed studies show values from $10.52 for picnicking to $100.22 for waterfowl hunting, but average around $37.00.

The 17 studies listed in Table 8B-1 are for nonfishing recreation valuation studies undertaken in Montana and the Rocky Mountain West. Table 8B-2 provides a more comprehensive summary of 181 nonfishing recreation studies undertaken throughout the United States from Walsh *et al.* (1988). This summary of studies, like the studies limited to Montana and the Rocky Mountain West, shows that activities like camping, picnicking, swimming, sightseeing, and hiking are valued somewhat less per day than floating or hunting. For comparison purposes, Table 8B-2 also reports an average value for cold water fishing. The lesser valued nonfishing recreation activities average 60 percent to 70 percent of the value of cold water fishing, while hunting and floating activities have a value roughly equivalent to or exceeding the value of fishing.

Table 8B-1
Literature-Based Average Net Benefits per Day for Recreational Activities Other than Fishing as Summarized by Walsh *et al.* (1988) and Smith and Kaoru (1990)

Authors (Date)/State	Activity and Method	Avg. Net Benefits per Day ($ 1992)*
Brown and Plummer (1979)/Washington	Hiking/Hedonic	$21.58
Walsh and Olienyk (1981)/Colorado	Hiking/On-site CVM	$16.08
Rosenthal and Walsh (1986)/Colorado	Hiking/On-site CVM	$29.97
Walsh and Olienyk (1981)/Colorado	Picnicking/On-site CVM	$10.52
Walsh *et al.* (1980)/Colorado	Picnicking/Open-ended CVM	$21.87
Michaelson (1977)/Idaho	Rafting/Individual TCM	$35.74
Walsh *et al.* (1980)/Colorado	Rafting/Open-ended CVM	$21.96
Young *et al.* (1987)/Idaho	Small game hunting/Open-ended CVM	$30.87
Brown and Plummer (1979)/Idaho	Small game/Hedonic	$49.19
Duffield and Neher (1991)/Montana	Waterfowl hunting/DC** - CVM	$100.22
Duffield (1988)/Montana	Elk hunting/TCM standard cost	$31.70
Duffield (1988)/Montana	Elk hunting/TCM reported cost	$83.61
Loomis *et al.* (1988)/Montana	Elk hunting/DC** - CVM	$51.07
Brooks (1988)/Montana	Deer hunting/Regional TCM	$64.81
Loomis (1988)/California	Viewing deer/CVM	$19.98
Markstrom and Rosenthal (1987)/Colorado	Gathering wood/Zonal TCM	$19.74
Daniels (1987)/Montana	Camping/Zonal TCM	$23.94

* Net benefits per day are the average for the study sample if calculated as such. In some cases, the study did not estimate net benefits on a per-day basis. In these cases, the net benefits are those derived from the estimates in the studies by Walsh *et al.* (1988).

** DC = Dichotomous Choice.

Table 8B-2
Net Economic Values per Day Reported by TCM and CVM Demand Studies from 1968 to 1988 Applied to National Forest Recreation Use Categories, United States ($ 1992)

Activity	Number of Estimates	Mean	Median
Camping	18	23.96	23.25
Picnicking	7	21.30	15.75
Swimming	11	28.22	22.86
Sightseeing	6	24.93	24.23
Hiking	6	35.74	29.02
Boating, nonmotorized	11	59.82	31.16
Hunting	83	51.23	42.86
Cold water fishing	39	37.62	35.01

Source: Walsh *et al.*, 1988.

McCollum *et al.* (1990) report net economic values for nonfishing recreation at national forests and for a region including Montana, Idaho, and South Dakota, which are presented in Table 8B-3. These estimates are based on a 1985-1986 Public Area Recreation Visitor Survey, a nationwide project by the Forest Service and other federal agencies. The Clark Fork River and Silver Bow Creek are not in a national forest, but the estimates are for similar activities in the region. These estimates are similar to those in Table 8B-1, but are on a per-visit basis. The central estimates range from $17 for sightseeing to $37 for wildlife observation. McCollum's estimate for cold water fishing is included for comparison purposes. The simple average of the nonfishing activities is $21 for the low estimates, $31 for the central estimates, and $36 for the high estimates. These average values are from 70 percent to 100 percent of the estimated value of a cold water fishing visit in this region. McCollum *et al.* note that their estimates are not adjusted for the proximity of substitute sites. However, the authors conclude that the values reported are conservative estimates of net benefits of the reported recreation activities because of analytical assumptions made. Again, these estimates are for each recreation visit.

Table 8B-3
Net Economic Values per Visit for Recreation Activities in National Forests:
Montana, Idaho, and South Dakota

Activity Type	Value per Person Trips ($ 1992)		
	Low	Central	High
Developed camping	$22.09	$34.62	$38.69
Wildlife observation	$33.70	$36.90	$40.10
Day hiking	$25.14	$37.84	$44.66
Picnicking	$22.90	$28.68	$32.24
Sightseeing	$3.28	$17.38	$26.61
Cold water fishing	$30.41	$35.42	$37.00

Source: McCollum *et al.*, 1990. Table 10.

Additional evidence on values specific to Southwestern Montana is provided by Duffield *et al.* (1990). This study surveyed anglers and nonanglers on the Bitterroot and Big Hole Rivers in 1988. The purpose of the study was to identify the value of instream flows in these streams. Dichotomous choice CVM models were used to value current visits by recreators. The parameters are highly significant, and the Chi-square statistic indicates the logit model provides a good fit to the data. The original data set can be disaggregated to estimate separate values for anglers and nonanglers. Estimated net economic value per visit from these models is reported in Table 8B-4. Based on the most conservative measure of average value (the median), nonfishing trips on the Bitterroot are valued at $51, and nonfishing trips on the Big Hole are valued at $119. On a value per-day basis, these estimates translate into $35/day on the Bitterroot and $65/day on the Big Hole. The median value for the Bitterroot is within the range of the averages reported in the literature for typical nonfishing recreation uses in Tables 8B-1, 8B-2, and 8B-3. The Big Hole value is high compared to the literature average and may reflect the special quality of this river as well as the social and economic characteristics of the users, many who are nonresidents. Note that average values in Table 8B-4 are also reported for fishing visits; on both rivers the nonfishing values per visit are from 65 percent to 81 percent of the value of the fishing visits. This is consistent with the relationship found in the literature reported in Tables 8B-2 and 8B-3.

Table 8B-4
Comparison of Net Economic Value per Trip for Nonfishing and Fishing Subgroups Derived from Bivariate Models of Willingness to Pay ($ 1992)

River/Sample	Median	T-Mean* ($500)	T-Mean ($1400)	T-Mean ($2000)
Bitterroot River				
Nonfishing value $ per trip	$51.07	$132.67	$188.29	$208.67
Fishing value $ per trip	$77.79	$179.86	$282.43	$323.48
Nonfishing value as a % of fishing value per trip	66%	74%	67%	65%
Big Hole River				
Nonfishing value $ per trip	$118.80	$206.80	$302.09	$335.36
Fishing value $ per trip	$174.42	$255.25	$399.22	$451.99
Nonfishing value as a % of fishing value per trip	68%	81%	76%	74%

Source: Derived from original data of Duffield *et al.*, 1990.
* T-mean is the truncated mean, a measure of central tendency computed by setting all values in the willingness to pay distribution above a given truncation level (for example, T = $500) equal to the truncation value.

The Big Hole and Bitterroot study (Duffield *et al.*, 1990) was only undertaken during the summer months. The distribution of activities found in this study is reported in Table 8B-5 along with the distribution found by Hagmann (1979) for the Clark Fork River and tributaries. The Clark Fork has relatively more camping use in the summer. The Bitterroot and Clark Fork are similar in the distribution of fishing and nonfishing recreational use, while use on the Big Hole is dominated by fishing.

The general finding of this literature review is that average values for nonfishing recreation trips are in the range of $30 to $40 and that nonfishing recreation values (excluding hunting) tend to be from 60 percent to 80 percent of fishing values. Applying the most conservative ratio of 60 percent to the average value per additional fishing trip would result in a unit value for each additional nonfishing recreation trip of $36.73 (the implicit $61.22 per additional fishing trip from Section 8.5 times 60 percent). These additional trips would be generated when the impacted sites are returned to baseline conditions.

Table 8B-5
Distribution of River Activities
Comparison of Hagmann, 1979 Clark Fork Estimates
and Duffield *et al.*, 1990 Bitterroot and Big Hole Estimates

Activity Type	Hagmann		Duffield *et al.*	
	Clark Fork Summer Use %	Clark Fork Annual Use %	Bitterroot Summer Use %	Big Hole Summer Use %
(A) Nonangling Activities				
Floating	6.3%	5.9%	11.9%	40.8%
Camping	56.8%	50.5%	1.2%	19.7%
Hunting	0.5%	9.1%	--	--
General shoreline	36.3%	34.4%	86.9%	39.4%
(B) All Angling Activities vs. All Nonangling Activities				
Angling	45.4%	47.1%	40.5%	87.7%
Nonangling	54.6%	52.9%	59.5%	12.3%

Source: Hagmann, 1979, Table 26, page 64; and Duffield *et al.* original data base.
Note: Percentages from Hagmann have been adjusted to reflect the exclusion of 950 summer and 262 winter "other" trips which could not be classified as either angler or nonangler.

A value of $36.73 is selected as the per-visit value to be applied to all impacted nonfishing recreation trips. This value is near the average of the unit values reported in Tables 8B-1, 8B-2, and 8B-3 and is less than the most directly applicable estimate of $51 for the Bitterroot River. In terms of the relative magnitude of nonfishing and fishing values, it is at the low end of the ratios found in the literature. In essence, this is a conservative interpretation of the values in the literature.

REFERENCES

Brooks, R. 1988. The Net Economic Value of Deer Hunting in Montana. Montana Department of Fish, Wildlife and Parks. Bozeman, MT.

Brown, G. and M.J. Plummer. 1979. Recreation Valuation. An Economic Analysis of Nontimber Uses of Forestland in the Pacific Northwest. Appendix A-5. Forest Policy Project, Washington State University, Pullman, WA.

Daniels, S.E. 1987. Marginal cost pricing and efficient provision of public recreation. *Journal of Leisure Research* **19**(1): 22-34.

Duffield, J. 1988. The Net Economic Value of Elk Hunting in Montana. Report for the Montana Department of Fish, Wildlife and Parks. Helena, MT.

Duffield, J., S. Butkay, and S. Allen. 1990. Economic Value of Recreation and Preservation Benefits of Instream Flow. Report for USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Duffield, J. and C. Neher. 1991. Montana Waterfowl Hunting: A Contingent Valuation Assessment. Report for the Montana Dept. of Fish, Wildlife and Parks. Helena, MT.

Hagmann, C. 1979. Recreational Use of the Upper Clark Fork River and Its Tributaries. Report for the Wilderness Institute, Montana Forest and Conservation Experiment Station, University of Montana. Missoula, MT.

Loomis, J., J. Cooper, and S. Allen. 1988. The Montana Elk Hunting Experience: A Contingent Valuation Assessment of Economic Benefits to Hunters. Report to the Montana Department of Fish, Wildlife and Parks. Helena, MT.

Markstrom, D.C. and D.H. Rosenthal. 1987. Demand and value of firewood permits as determined by the travel cost model. *Western Journal of Applied Forestry* **2**(2): 48-50.

McCollum, D., G.L. Peterson, J.R. Arnold, D.C. Markstrom, and D.M. Hellerstein. 1990. The Net Economic Value of Recreation on the National Forests: Twelve Types of Primary Activity Trips Across Nine Forest Service Regions. Research Paper RM-289, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Michaelson, E. 1977. An Attempt to Quantify the Aesthetics of Wild and Scenic Rivers in Idaho. p. 320-328. In Proceedings of a Symposium on River Recreation Management and Research, General Technical Report NC-28, North Central Station, Forest Service, USDA. St. Paul, MN.

Rosenthal, D.H. and R.G. Walsh. 1986. Hiking values and the recreation opportunity spectrum. *Forest Science* 32(2): 405-415.

Smith, V.K. and Y. Kaoru. 1990. Signals or noise? Explaining the variation in recreational benefit estimates. *American Journal of Agricultural Economics* 72: 419-433.

Walsh, R., R. Aukerman, and R. Milton. 1980. Measuring Benefits and the Economic Value of Water in Recreation on High Country Reservoirs. Colorado Water Resources Research Institute, Colorado State University, Fort Collins, CO.

Walsh, R.G., D. Johnson, and J. McKean. 1988. Review of Outdoor Recreation Economic Demand Studies with Nonmarket Benefit Estimates. Colorado Water Resources Research Institute Technical Report No. 54. Colorado State University, Fort Collins, CO.

Walsh, R.G. and J.P. Olienyk. 1981. Recreation Demand Effects of Mountain Pine Beetle Damage to the Quality of Forest Recreation Resources in the Colorado Front Range. Report to the Forest Service by the Department of Economics, Colorado State University, Fort Collins, CO.

Young, J.S., D.M. Donnelly, C.F. Sorg, J.B. Loomis, and L.J. Nelson. 1987. Net Economic Value of Upland Game Hunting in Idaho. Resource Bulletin RM-15, Rocky Mountain Forest and Range Experiment Station, Forest Service, USDA. Fort Collins, CO.